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## Sequential Testing Effects Re-Visited : Is the Effect of Test Presentation Contingent Upon Slide Linearity?

John D. Jones  
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Running head: SEQUENTIAL PRESENTATION AND THE MISINFORMATION EFFECT

Sequential Testing Effects Re-Visited: Is The Effect of Test Presentation Contingent  
Upon Slide Linearity?

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## Abstract

Evidence regarding the potential mediating effects sequential test presentation has upon eyewitness suggestibility is divided. Bekerian and Bowers' (1983) research suggested that sequential test presentation reduced misinformation effects, whilst McCloskey and Zaragoza's (1985) results failed to indicate any effect of this presentation method. A possible reason for these conflicting results is that the respective research groups have used different sets of slides. Bekerian and Bowers' (1983) slides appeared to contain more thematic content (i.e., linear content), which in turn increased participants' resistance to misleading postevent information. Conversely, McCloskey and Zaragoza's (1985) slides appeared to lack this feature (i.e., they are non linear). Therefore, it was suggested that the influence that sequential testing had upon misinformation effects was mediated by the amount of linear content present amongst the slides used by the previous researchers. The present study was designed to evaluate this hypothesis. One hundred and twelve participants were assigned to one of four conditions, which involved a combination of two critical manipulations: the degree of linearity present in slides (linear vs. non linear) and test presentation order (sequential vs. random). To simulate a misinformation effect, participants were exposed to both consistent (control) and inconsistent (misled) postevent items. The dependent variable involved participant's recognition difference performance, which was created by subtracting participants' misled item performance scores from their control item performance scores. One sample  $t$  tests were then used to compare each of the four cells recognition difference scores. Any scores which were significantly higher than zero were interpreted as being indicative of a misinformation effect. All four of the cells' recognition difference scores were in the direction consistent with a misinformation effect (i.e., a positive score). However, only one of the cells (i.e., the linear-sequential cell) reported a significant misinformation effect. In the other three cells, the recognition difference scores were not significantly higher than zero, although the non linear-random cell test result was only marginally non

significant. This pattern of results was inconsistent with the experimental hypothesis. Had this been supported, the two non linear cells would also have displayed misinformation effects. Furthermore, results failed to confirm McCloskey and Zaragoza's (1983) predictions that all four of the cells would experience misinformation effects, regardless of test presentation. The misinformation effect detected in the linear-random cell, and the trend toward such an effect found in the non linear-random cell suggested that the influence sequential testing had upon misinformation effects was independent of slide linearity. This pattern of results was consistent with Bekerian and Bowers' (1983) hypothesis. The implications and validity of these results are discussed.

Declaration

I certify that this thesis does not, to the best of my knowledge and belief:

- (i) incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher education;
- (ii) contain any material previously published or written by another person except where due reference is made in the text; or
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A black rectangular box redacting the signature of John D. Jones.

John D. Jones

### Acknowledgments

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# Chapter 1: Previous Research Concerning The Misinformation Effect

In the interval between the observation of a criminal incident and its subsequent recollection, eyewitnesses will inevitably encounter information which is relevant to this event (Bowers & Bekerian, 1984; Loftus, 1979a). This information may come from a variety of sources (e.g., investigating police, fellow witnesses, media) and will vary in the degree of similarity it shares with the eyewitness' original memory. Some of this subsequent information may be clearly inconsistent with what actually occurred. In light of this, it seems pertinent to ascertain what effect such inaccuracies have upon eyewitnesses' memories.

Interest in this question has resulted in numerous studies which have attempted to evaluate the impact of inconsistent postevent information. Much of the early research concerned with such effects can be attributed to Loftus and her associates (e.g., Loftus & Palmer, 1974; Loftus, 1975, 1979a, 1979b). One of Loftus' most influential contributions has been the *three phase paradigm*, a procedure first used by Loftus (1977) which is still widely employed almost 20 years later (e.g., Roediger, Jacoby & McDermott, 1996; Weingardt, Loftus & Lindsay, 1995; Wright, Varley & Belton, 1996). During the first phase of this procedure, individuals view a set of stimuli which depict a series of events. For example, during a series of experiments reported by Loftus, Miller and Burns (1978), participants were exposed to a succession of slides which displayed a traffic accident in which a car was seen striking a pedestrian. Phase Two involved introducing some form of written postevent information. For participants in the control group, all of the written information was consistent with what was depicted in the slides. However, for participants in the experimental, or *misled* group, the postevent information contradicts one aspect, or *critical item*, that occurred during the first phase. During the Loftus et al. (1978) study, for example, participants in

the control group who saw a stop sign displayed in the slides were asked 'Did another car pass the red Datsun when it stopped at the *road* sign?', whereas the misled group were asked 'Did another car pass the red Datsun when it stopped at the *yield* sign?'. The final phase of this procedure requires participants to complete a forced choice recognition test. During this task participants are presented with a series of target-distracter pairs. Of this pair, the target or *original item* refers to the item, whereas the distracter refers to the item suggested during the postevent manipulation (hereafter referred to as the *postevent item*). The participants' objective is to indicate which of these items they believed they saw in the first phase. Results from studies which have employed the three phase paradigm typically reveal a *misinformation effect*. That is, misled participants perform significantly worse upon the critical item<sup>1</sup> than their control counterparts (e.g., Bekerian & Bowers, 1983; Bonto & Payne, 1991; Bowers & Bekerian, 1984; Loftus, Miller & Burns, 1985; McCloskey & Zaragoza, 1985).

Whilst the misinformation effect has proved to be an enduring phenomenon, considerable disagreement has occurred between researchers who have attempted to identify the processes underlying this effect (Belli, 1989; Loftus, Schooler & Wagenaar, 1985). Numerous theories have been proposed to account for the negative effect of inconsistent postevent information. Generally, such accounts can be separated according to the role they assign the eyewitness' memory for the original item. *Memory impairment* theories have proposed that inconsistent postevent information interferes with the original memory by either replacing the original memory (*alteration hypothesis*) or rendering it inaccessible (*coexistence hypothesis*). Conversely, the *misinformation acceptance hypothesis* postulates that

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<sup>1</sup> It is worth noting that the effect of inconsistent postevent information is specific to the critical item it refers to. That is, misled participants do not perform significantly worse than control participants for any of the items they were not misled upon.

misinformation can only affect subsequent recollections if the original memory is forgotten prior to the introduction of postevent information. Finally, *source monitoring theory* suggests that misinformation effects occur when confusions arise regarding the context in which a particular memory was acquired (i.e., participants incorrectly believe they saw the postevent item and read the original item). The aim of the following section is to discuss each of these theories in greater detail, before introducing more recent research, and finally summarising the pertinent findings.

### Interpreting the Misinformation Effect: Major Theories

#### Misinformation Impairs the Original Memory

As discussed above, both the alteration and coexistence hypotheses supported the notion that misinformation reduces participants' memories for the original item. Whilst both of these accounts suggest memory impairment, they differ in the 'fate' they allocate to the original item upon the introduction of postevent information (Loftus & Loftus, 1980). Advocates of the alteration account (e.g., Loftus & Loftus, 1980) suggested that the original item was replaced in the long term memory store by the postevent item. In contrast, supporters of the coexistence account (Bekerian & Bowers, 1983; Christiaansen & Ochalek, 1983) proposed that the introduction of misinformation created an additional memorial representation (i.e., the postevent item exists alongside the original), which in turn affected the accessibility of the original memory.

The different emphasis each hypothesis places upon the permanence of the original memory has profound forensic implications, as each account makes different claims regarding the veracity of eyewitness testimony once misleading information has been provided. From the alteration perspective, memories are irrevocably altered by misinformation, and thus once contaminated, are of little use to the forensic practitioner (Bowers & Bekerian, 1984). The coexistence hypothesis offers a more optimistic alternative, as even if postevent information is incorporated into the long term store, the original memory still exists, albeit in a less accessible form (Bowers & Bekerian, 1984). Therefore, the differences

between the two memory impairment hypotheses is not only of theoretical interest, it also has real life applications.

The importance of determining which of these accounts was correct led Loftus (1979b) to slightly deviate slightly from her previous procedure (i.e., Loftus et al., 1978). The adaptation occurred in the final phase, and involved participants being confronted with a three item forced recognition test consisting of the original item (e.g., stop sign), the postevent item (e.g., yield sign) and a novel item (e.g., no parking sign). During this phase, participants were required to indicate the item they believed they saw during the slides, as well as nominating a second item on the proviso that their first selection may have been incorrect. Loftus (1979b) assumed that this 'second guess' was sensitive to coexisting memories (i.e., misled participants who selected the postevent item first, should still have 'second guessed' the original item). In all three of Loftus' (1979b) 'second guess' experiments, the second guess accuracy of the misled participants who initially selected the postevent item did not exceed chance.

A second study which merits consideration in the alteration-coexistence debate, was reported by Greene, Flynn and Loftus (1982). During this study misled participants received a warning that some of the postevent information 'may have been inaccurate' either *before* or *after* they were exposed to misinformation. In addition to these two groups, there was also a misled 'control' group which received no warning. The purpose of providing a warning after the postevent manipulation was to allow participants to search their memories for the original item. The inclusion of the group warned prior to the misinformation allowed Greene et al. (1982) to determine if warnings increased resistance to inconsistent postevent information. The only significant difference found between the three groups was that the 'before warning' condition had fewer incorrect responses than the control group. Whilst this suggested warnings could decrease misinformation effects if they preceded postevent information, failure to find a reliable 'after warning'-control

difference, coupled with the results from the 'second guess' experiments led Loftus and her colleagues to conclude that postevent information altered participants' memories irreparably (Greene et al., 1982; Loftus & Loftus, 1980).

Another study which warrants discussion is that conducted by Loftus (1977). In terms of misinformation effect research this study contained a number of important differences. One difference involved the choice of the critical item. Whereas preceding research (e.g., Loftus et al., 1978) used objects (e.g., road sign) as the basis for the postevent manipulation, the postevent manipulation used during the Loftus (1977) experiment involved the *colour* of the pedestrian's shirt. A further difference occurred during the third phase of the experiment. In contrast to future research which used two test pair alternatives (i.e., postevent item, original item), Loftus (1977) included several other alternatives. Loftus (1977) found a significant amount of cases whereby misled participants reports concerning the critical item (e.g., the color of a pedestrian's shirt), displayed a 'blend' (hereafter referred to as *compromise retrievals*) comprising of the original and postevent item (e.g., a yellow original item and blue postevent item elicited a 'green' response). Such results have since been replicated by Belli (1988). The nature of these compromise retrievals led Loftus (1977) to conclude that the alteration hypothesis was responsible for misinformation effects. From this perspective compromise retrievals were seen as being caused by a process in which the alteration of the original item (i.e., the postevent item replacing the original) was incomplete, resulting in fragments of the original item still existing. The partial existence of the original memory resulted in a combination between the postevent and original items, hence the compromise retrievals.

Whilst the studies discussed above seemed to provide support for the alteration hypothesis, Loftus and her associates were quick to acknowledge that this support was somewhat tenuous (Loftus, 1979b; Loftus & Loftus, 1980). The essence of this warning lies in the fact that whilst the discovery of the original memory would provide clear support for the coexistence hypothesis, failure to do so

provides only suggestive support for the alteration hypothesis. Bearing this in mind, neither the blend studies (Belli, 1988; Loftus, 1977) or the warning studies (Greene et al., 1982; Loftus, 1979b) can be said to have produced conclusive evidence for the alteration account.

Whilst the discovery of 'blends' may seem to suggest a subtle form of alteration, the coexistence hypothesis can also provide an explanation for such results. Belli (1988) has suggested that such effects may be caused by the two items (postevent, original) reducing each others' accessibility so that neither predominates, thereby creating a tendency to select the blend response option. Furthermore, since no other research concerning blends has been conducted, it is impossible to suggest which of these conclusions is correct. In terms of the warning studies, it would be reasonable to conclude that during both the Greene et al. (1982) and Loftus (1979b) experiments, the original memory may have existed, and that its failure to be consistently reported by misled participants was due to external conditions which reduced its accessibility (i.e., thereby increasing the postevent item's availability). This possibility led researchers to revise experimental procedures, so that if the coexistence hypothesis were indeed correct, the original memory could be more readily accessed.

Christiaansen and Ochalek (1983) appear to be the first researchers to have revised their experimental procedures for such a purpose. Reasoning that the warning used by Greene et al. (1982) was not explicit enough ('some of the things you read may have been inaccurate'), Christiaansen and Ochalek (1983) introduced a more direct warning. The purpose of this warning was to motivate misled participants to institute a more exhaustive search of their memory. The distribution of this warning was divided amongst two groups: a biased-immediate condition, whom were given the warning directly after the postevent information and a biased-delayed condition, which received a warning 45 minutes later. In addition to these two groups there was also a group which received no misinformation (neutral condition), as well as a group which received misinformation, yet no warning



(biased). All four of these groups were given a recognition test after viewing the slides (i.e., prior to the postevent and final recognition test phases), and were excluded from further testing if they failed. This was done to ensure that only participants who had originally encoded the critical item (i.e., possessed the original item) were included in the final analysis.

As had occurred in previous studies, participants who received misinformation (e.g., biased, biased-delayed, biased-immediate) performed less accurately on the critical item, than those who did not (e.g., neutral). However, participants in the two biased conditions (e.g., biased-delayed, biased-immediate) which received a warning were significantly more likely to respond correctly than misled participants who were not exposed to this feature (e.g., biased) (Christiaansen & Ochalek, 1983, Experiment 2). To ensure participants who received the warning chose the original item because they truly remembered it, rather than merely responding to demand characteristics (i.e., rejecting the postevent item, as the experimenter had warned it was inaccurate), Christiaansen and Ochalek (1983, Experiment 3) repeated their procedure, but also warned participants in the neutral condition. Contrary to this 'narrative rejection hypothesis', results indicated that whilst warnings increased biased performance, *the warnings did not decrease the neutral conditions' accuracy*. On the basis of these results, Christiaansen and Ochalek (1983) decided in favour of the coexistence hypothesis.

Further support for the coexistence account was provided by Bekerian and Bowers (1983). Using the traditional misled and control groups, these researchers also included an additional manipulation. Half of the participants received their test slides in random order (as had been the case in previous research), whereas the other half received theirs in sequential order. The expected misled-control difference was found amongst the random condition, however this effect was not found amongst the sequential condition. In applying the principles espoused by *the encoding specificity principle* (cf. Tulving & Thompson, 1973), Bekerian and Bowers

(1983) suggested that this effect was due to the experimental group receiving conditions that favoured the retrieval of the original item from memory. That is, sequential test presentation matched the conditions the original item had been presented in, thereby increasing the accessibility of this particular item. Conversely, as the random group were not exposed to retrieval conditions that matched those present during encoding, the more recent postevent item was more likely to be accessed from memory.

Building on their previous work, Bowers and Bekerian (1984) increased the scope of their investigation concerning retrieval cues. Essentially this study was identical to the previous work conducted by these researchers (i.e., it had both sequential/random testing conditions and misled/control participants). However, Bowers and Bekerian (1984) also manipulated the order in which participants received their postevent information. That is, half of the participants received their postevent questions in chronological order (sequential), whilst the other half received their questions in a random fashion. Bowers and Bekerian (1984) reported a replication of their previous results amongst participants who had received their postevent questions in random order (i.e., sequential testing eliminated misled-control differences). However, the effect of sequential testing did not extend to the participants who were exposed to sequential postevent questioning. This effect was predicted by Bowers and Bekerian (1984), as they claimed that by presenting postevent information in a manner similar to the original event (and in the sequential test conditions, similar to the test itself), they had created encoding conditions that closely matched those under which the original event had been experienced. From this perspective, reinstating the encoding context at the time of testing (i.e., sequential testing) would have little impact upon the accuracy of misled participants, as these encoding conditions were no longer unique to the original memory.

Both Christiaansen and Ochalek (1983) and Bekerian and Bowers' (1983; Bowers & Bekerian, 1984) seemed to have convincingly demonstrated that

coexisting memories were created by postevent information. The Bekerian and Bowers studies were particularly important in this respect, as they accounted for the null results reported by previous investigators (Greene et al., 1982; Loftus, 1979b). It was for this reason that, following the publication of these results, the coexistence hypothesis temporarily became the dominant explanation of the misinformation effect.

#### Poor Misled Performance is An Artefact Caused By Response Biases

This dominance was short lived however, as the validity of memory impairment (upon which the coexistence hypothesis is based) was called into question when McCloskey and Zaragoza (1985) proposed an alternative hypothesis. Unlike memory impairment hypotheses, McCloskey and Zaragoza's (1985) misinformation acceptance hypothesis does not attribute poorer misled performance to memory deficits caused by inconsistent postevent information. In essence, the misinformation acceptance hypothesis is made up of two separate explanations, the *deliberation explanation*, and the *non retention explanation* (McCloskey & Zaragoza, 1985; Zaragoza, McCloskey & Jamis, 1987). The deliberation explanation suggests that the introduction of inconsistent postevent information exposes misled participants to demand characteristics (e.g., the assumption that the experimenter more likely to remember what was seen, and thus the postevent information must be correct). From this perspective, even if misled participants do remember the original event, such pressures may cause a large proportion of this group to base their response on the more recent (and erroneous) postevent information. The non retention explanation suggests that misinformation effects are essentially the cause of participants forgetting<sup>2</sup> the original item prior to the introduction of postevent

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<sup>2</sup> For the sake of brevity, McCloskey and Zaragoza (1985) used the terms 'remember' and 'forget'. However, this does not mean that they have assumed the memory trace is completely non-existent, "... the arguments we developed (and those we make subsequently) are unaltered if we assume that subjects can have partial

information. Participants in the misled group who forget the original item independently of the experimental manipulation, may remember the postevent item and base their responses on this erroneous detail. Control participants are not exposed to this bias, as even if they can not remember the original event, they can guess and will be right at least 50% of the time. Based on this explanation, poorer misled performance is still expected, even when an equal proportion of individuals in control and misled groups remember the original item. By combining these two explanations, the misinformation acceptance hypothesis provided a reasonable alternative to the notion of memory impairment.

In order to test the veracity of the misinformation acceptance hypothesis, a procedure needed to be developed which was sensitive to the potential impairing effects of misinformation, yet at the same time avoided confounding both demand characteristics (i.e., deliberation) and differential guessing (i.e., non retention) (Zaragoza & McCloskey, 1989). Research conducted by Weinberg, Wadsworth and Baron (1983) represents the first attempt to balance these two issues. The only difference between the Weinberg et al. (1983) procedure, and the earlier misinformation research lay in the forced choice recognition phase each employed. Whereas participants in previous studies were confronted with either the original or postevent item, the test during the Weinberg et al. (1983) study consisted of the original item and a novel item derived from the same category as the original/postevent items. Subsequent authors (e.g., Belli, 1989; Tversky & Tuchin, 1989; Zaragoza & McCloskey, 1989) have referred to the traditional test as the *standard test*, whilst labelling the Weinberg et al. (1983) procedure as the *modified test*. The rationale behind employing the modified test is that by replacing the postevent item, the influence of response biases (i.e., caused by deliberation and non retention) are eliminated, whilst the ability to detect impairment is retained

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memory for original or misleading information" (McCloskey & Zaragoza, 1985, p. 4).

(Weinberg et al., 1983; McCloskey & Zaragoza, 1985; Zaragoza & McCloskey, 1989; Zaragoza et al., 1987). That is, if participants' memories were affected by the postevent information, misled participants would not select the original item on the test, thereby replicating previous research. Alternatively, if response biases were the underlying factor, there would be no misled-control difference. Results from this study indicated a significant misled-control difference, evidence which led Weinberg et al. (1983) to conclude that memory impairment, rather than response biases were the cause of memory impairment.

McCloskey and Zaragoza (1985) provided an alternative interpretation of the Weinberg et al. (1983) study, claiming that the choice of test stimuli, combined with a failure to counterbalance, biased results. Participants in the Weinberg et al. (1983) study were exposed to the slides originally used by Loftus et al. (1978). Unfortunately, unlike the Loftus et al. (1978) study, Weinberg et al. (1983) did not counterbalance their items. That is, each participant viewed a yellow yield sign and were given a red yield sign as a distracter (the novel item). Misled participants received postevent information referring to this critical item as a 'stop sign', whereas the control group were exposed to information which labelled this merely as a 'road sign'. Extending the notion of non retention, McCloskey and Zaragoza (1985) contended that participants exposed to inconsistent postevent information were subjected to a unique bias:

Faced with a yellow yield sign versus red yield sign test, it seems likely that many of those subjects would choose the alternative most similar to the stop sign; that is, the red yield sign. Thus, among subjects who did not remember the original information, the misleading information may have created a bias toward selection of the incorrect test alternative. This response bias is simply a milder form of the bias in the original test procedure, where the misleading information is identical, not merely similar to the incorrect test alternative

(McCloskey & Zaragoza, 1985, p. 8).

Using a new set of slides which depicted an office burglary, and allowing for the counterbalancing of critical items, McCloskey and Zaragoza (1985) exposed their participants to two experimental manipulations. The first of these was the traditional postevent manipulation, resulting in two groups; misled and control. The second involved the type of recognition test. Half of the sample received the modified test (i.e., original/novel items) whilst the remaining participants completed the standard test (i.e., original/postevent items). Results appeared to be consistent with McCloskey and Zaragoza's (1985) claims, as a significant misled-control difference was found only in the standard test condition.

As previous research (e.g., Postman & Underwood, 1973) had demonstrated that recall memory was more sensitive to retroactive interference than recognition memory, Zaragoza et al. (1987) reasoned that a failure to detect a misinformation effect via recall procedures would provide further support for the misinformation acceptance account. With this in mind, Zaragoza et al. (1987) exposed half of their participants to a standard recognition test, whilst the other half received a cued recall test. The switch to recall required these researchers to restructure their stimulus materials and test questions so that the inconsistent postevent items were not correct responses to the critical item (cued recall) questions. For example, if the original item was a *Coke can*, the postevent item suggested to misled participants was a *can of Planter's peanuts*. The critical test question for this item was 'The keys to the desk drawer were next to a soft drink can. What BRAND of SOFT DRINK was it?'. By including such a manipulation, Zaragoza et al. (1989) assumed that they had developed a procedure that was sensitive to possible memory impairment, and avoided confounds due to deliberation/non retention. Consistent with the predictions made by Zaragoza et al. (1987), results indicated that a significant difference between the misled and control groups occurred in the standard recognition group, yet not in the recall condition.

The results of the McCloskey and Zaragoza (1985) and Zaragoza et al. (1989) studies appeared to indicate that response biases, rather than memory impairment were responsible for misinformation effects. Encouraged by these results, McCloskey and Zaragoza (1985; Zaragoza & McCloskey, 1989) attempted to apply the principles of deliberation and non retention to account for previous research findings. From this perspective, results obtained during the 'second guess' studies (e.g., Loftus, 1979b) merely reflected non retention. That is, the poor accuracy of misled participants' second responses could be interpreted as evidence that they never remembered the original item, even prior to the introduction of postevent information, and thus could not be expected to 'second guess' above chance (McCloskey & Zaragoza, 1985). Misinformation acceptance was also used to account for the 'blend' responses reported by Belli (1988) and Loftus (1977). Zaragoza and McCloskey (1989) contended that such responses were the result of a subtle form of deliberation which occurred when participants remembered both the original and postevent items. In such cases, the assumption that the experimenter was correct, caused participants to modify their response in order to reflect compromise between the two alternatives. The application of misinformation acceptance has also been applied in order to account for the results obtained by 'warning studies'. The notion that participants who forget independently of the postevent manipulation can certainly account for research in which no effect of a warning was found (e.g., Greene et al., 1985), as all the misled groups, regardless of the presence of a warning, can be assumed to select the postevent item as they are presumed to have trusted the veracity of its source. Such a conclusion becomes a little more problematic in Christiaansen and Ochalek's (1983) case, where a warning was used to override the initial deleterious effects of misinformation. However, McCloskey and Zaragoza (1985) claimed that the warning caused misled participants who did not remember the original information (i.e., they either forgot after the initial test, or did not remember even at this stage and guessed initially) to reject the postevent

information, guess the correct response, and subsequently perform in a manner comparable to their control counterparts.

The only previous findings that can not be adequately explained by the misinformation acceptance hypothesis, are those reported by Bekerian and Bowers (1983; Bowers & Bekerian, 1984). It is unreasonable to suggest that differential guessing/ demand characteristics could be mediated merely by the order in which postevent and test items are presented, a fact acknowledged by McCloskey and Zaragoza (1985) themselves. This point, and McCloskey and Zaragoza's (1985) own findings regarding sequential testing, will be discussed in greater detail further on in this paper. The purpose for discussing the issue at this stage is merely to highlight the fact that the misinformation acceptance hypothesis, like its predecessor memory impairment, is not without its flaws. Bearing this in mind, it seems appropriate to explore subsequent research which contradicts McCloskey and Zaragoza's (1985) position. These points can be classified into two main categories, the first of which relate the recall procedure developed by Zaragoza et al. (1987). The second category is concerned with McCloskey and Zaragoza's (1985) use of the modified recognition test.

As Zaragoza et al. (1987) have stated, failure to detect misled-control differences using the modified recall procedure provided strong evidence against memory impairment. However, based on previous research conducted by Loftus (1979a), there is good reason to question the validity of Zaragoza et al. (1985) results. Loftus (1979a) found that inconsistent postevent information only distorted participants' responses when it was credible- postevent items which blatantly contradicted what actually occurred did not affect the accuracy of participants' subsequent responses. The reason for this, Loftus (1979a) contended, was that the contradictory nature of the postevent information caused participants to detect the discrepancy between the original and postevent items, thereby resulting in



the postevent item being excluded from participants' memories<sup>3</sup>. Further support for Loftus's (1979a) notion of *discrepancy detection*, was provided by Tousignant, Hall and Loftus (1986), who found that misinformation effects were more likely to occur amongst those who read the postevent information quickly. The obvious implication of these results was that fast readers were less likely to process material as deeply as slow readers and thus, less likely to notice the original-postevent item discrepancy.

During the Zaragoza et al. (1987) study, postevent items came from a different category (e.g., can of Planter's peanuts) to which the original item (e.g., soda can) was derived. In light of Loftus's (1979a) results, a plausible alternative to Zaragoza et al. (1987) explanation exists. That is, a misinformation effect did not occur as the postevent information was blatantly different to what actually occurred, and as such was not incorporated into misled participants' memories prior to the final test. However, whilst this is a plausible alternative to the explanation offered by Zaragoza et al. (1987), it is unclear if it is the correct explanation, as it has not yet been tested.

The research conducted by Zaragoza et al. (1987) was not the only study to attract criticism, as McCloskey and Zaragoza's (1985) research which used a modified recognition procedure has also been challenged. Contrary to McCloskey and

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<sup>3</sup> Whilst Loftus (1979a) believed these results reflected alteration based memory impairment, they can be explained by other accounts. The coexistence impairment account would also claim that the blatant nature of the postevent information results in it being omitted in memory. The essential difference being that, if it was accepted by participants, it would be stored (rather than placed over) next to the original item. The misinformation acceptance hypothesis makes a different claim- the blatant nature of the misinformation causes participants to doubt the credibility of the source (e.g., questionnaire), which in turn causes participants to avoid biases related to deliberation.

Zaragoza's (1985) findings, there have been some instances in which misinformation effects have been detected using modified test procedures. Chandler (1989; 1991) is one such reporter who has detected misled-control differences, whilst using the modified test procedure. Whilst these results appear to challenge the misinformation acceptance hypothesis, it is worth noting that Chandler (1989; 1991), unlike previous researchers used stimuli (e.g., pictures of landscapes) that were not forensically related. As such, several authors (Belli, Lindsay, Gales & McCarthy, 1994; Belli, Windschitl, McCarthy & Winfrey, 1992) have expressed concern regarding the generalisability of Chandler's (1989; 1991) findings.

Misinformation effects under modified test conditions have not been restricted to Chandlers' (1989; 1991) work, as some investigators (Ceci, Ross & Toglia, 1987; Belli, et al., 1992; cf. Payne, Toglia & Anastasi, 1994) who have used forensically relevant stimuli have also detected significant misled-control differences. Whilst the presence of such results support the notion of memory impairment, and thereby challenge the misinformation acceptance hypothesis, it is worth noting that a meta analysis conducted by Payne et al. (1994) found that the vast majority (i.e., 30 out of 44 published cases) of studies which have used the modified test procedure failed to find misinformation effects. Therefore, any explanation that uses some aspect of impairment to account for these significant results, must also explain why the vast majority of studies *have not* found such effects. Whilst several authors have attributed the two different sets of findings to recognition performance levels (Chandler, 1989; Payne et al., 1994)<sup>4</sup>, it is also

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<sup>4</sup> Both Chandler (1989) and Payne et al. (1994) have suggested that control performance affects the magnitude of the misinformation effect. Put simply, in order to obtain a significant misled-control difference when using a modified test, performance can not afford to be either too high or too low. If it is too high, participants will not incorporate the postevent item into their memories. On the other hand, if it is too low, participants may still guess the correct item, even when

possible that these antagonistic results may merely reflect variations in methodology (e.g., sampling error, measurement differences) used by the respective research groups (Payne et al., 1994). As little research has examined the effect of recognition levels on misled-control differences, it is unclear as to which of these conclusions is correct.

Another criticism of McCloskey and Zaragoza's (1985) results involves the omission of the postevent item from the final test. As has already been discussed, their justification for this manipulation was that it avoided deliberation/non retention confounds, whilst still remaining sensitive to the potential impairing effects of inconsistent postevent information. Whilst such a test may be capable of detecting the type of impairment in which the original item is irrevocably altered during the postevent phase (ala alteration), several researchers (e.g., Belli, 1989; Tversky & Tuchin, 1989) have contended that the modified test is insensitive to the type of impairment in which the postevent and original memories remain together in memory (i.e., coexistence). Using the principles outlined by the encoding specificity principle (cf. Tulving & Thompson, 1973), these authors asserted that by presenting the original item in the absence of its postevent rival (this is replaced by a novel item), test conditions are clearly biased toward the retrieval of the correct item. If this was the case, it would be reasonable to expect that the misled and control groups would perform equivalently, *even if the misled group's memories were impaired*<sup>5</sup>

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their memories are impaired (remember, the modified test does not offer the postevent item as an option), and perform at around chance levels. For a more detailed discussion of this explanation the reader is directed to Chandler's (1989) paper.

<sup>5</sup> Even from a misinformation acceptance perspective, the postevent manipulation may not have worked. As McCloskey and Zaragoza (1985) have acknowledged, participants need only to remember seeing a soda can (they don't have to remember

Evidence for this alternative explanation have been provided from two sources. The first of these was provided by Loftus et al. (1989). Essentially, this study was an exact replication of McCloskey and Zaragoza's (1985) work. The independent variables were exactly the same; there was the misled-control manipulation, as well as the standard and modified test conditions. The defining feature was that in addition to recognition performance, participants' reaction times were included as a separate dependent variable. In terms of recognition performance, Loftus et al. (1989) duplicated McCloskey and Zaragoza's (1985) results (i.e., a misinformation effect occurred only in the standard test condition). Regarding the reaction time measure, misled participants did not respond more slowly overall. However, the misled group did respond more slowly than control participants *in the modified condition*. Loftus et al. (1985) suggested that these slower times were caused by the postevent items absence on the final test, which in turn caused participants to conduct a more exhaustive (and lengthy) search of the memory store.

Caution must be exercised in accepting this explanation, however, as this does not represent the only interpretation. Zaragoza and McCloskey (1989) have also proposed alternative explanation which can also account for the Loftus et al. (1989) results. They contended that during the postevent phase, misled participants who did not remember the original item were merely acquiescing to biases associated with either demand characteristics or non retention. Upon being confronted with the modified test, a test in which the suggested item is conspicuously absent, these participants would be forced to guess. As this explanation also predicted longer

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if it was a Coke, Sunkist, 7 Up or Sprite) in order to eliminate the effects of inconsistent postevent information. Even this level of detail is not required- in order to avoid the effects of postevent information, participants merely need to remember that the item they saw *was not* a 'can of Planter's Peanuts', a far easier task than having to remember exactly what it was they actually witnessed.

reaction times for participants who were exposed to both misinformation and the modified test, the Loftus et al. (1989) results could not be used to resolve whether or not the absence of the postevent item did indeed interfere with the accessibility of the original trace.

The second piece of research which attempted to address this controversy was conducted by Belli (1989, Experiment 2). Like previous research, Belli's (1989) research contained the familiar control and misled groups. However, the distinguishing feature of Belli's (1989) work was the final test; half of the participants were received the original item, the other half received a novel item. Participants were then expected to indicate via a 'yes' or 'no' response, whether or not they had previously encountered the item (so far no one has endeavoured to label this the modified-modified test procedure). According to Belli (1989), this response format avoided the response biases outlined by McCloskey and Zaragoza (1985), as well as being sensitive to impairment related to *coexisting* memories. That is, this technique did not include the postevent item, yet at the same time the 'no' response allowed misled participants who believed they saw the postevent item the chance to express this belief. Analysis revealed that in comparison to the control group, misled participants were less likely respond correctly (i.e., a correct response being either 'yes' for the original item or 'no' for the novel alternative). These results were subsequently replicated by McCloskey and Zaragoza (1989). Both Belli (1989), as well as Tversky and Tuchin (1989) claimed these results demonstrated that misinformation effects were due to coexistence-based memory impairment. Zaragoza and McCloskey (1989) were not so sure. Their interpretation suggested that the postevent item merely undermined misled participants' confidence in their memories for the original item, which in turn caused this group to respond less accurately.

As can be seen, the misinformation acceptance hypothesis has created a great deal of controversy. Overall, it provides a reasonable alternative to the memory impairment hypotheses, yet it has not been within its critics. Whilst some

researchers (e.g., Belli et al., 1992; Chandler, 1989; 1991) failed to replicate previous findings which supported the misinformation acceptance hypothesis, it is worth noting that the majority of researchers who have employed modified test procedures have decided in favour of McCloskey and Zaragoza's (1985) conclusions. In spite of these favourable results, the modified test procedure could be criticised either for not being sensitive to memory impairment (Belli, 1989; Tversky & Tuchin, 1989), or, as was the case with Zaragoza et al. (1987) using postevent items so blatantly contradictory that the effect of the manipulation was nullified. However, it is unclear as to whether these criticisms are valid, as in the case of the former criticism an alternative explanation exists, whereas the latter criticism has not been subjected to scientific analysis.

#### Misinformation Effects Are the Product of Source Misattributions

The final explanation of the misinformation acceptance hypothesis discussed in this paper relates to source monitoring. Source monitoring refers to the mental activity individuals use in order to identify the origin (or source) of internal knowledge representations (e.g., memories, beliefs) (Hashtroudi, Johnston & Chrosniak, 1989; Johnston, 1988; Johnston, Hashtroudi & Lindsay, 1993; Lindsay, Johnston & Kwon, 1991; Zaragoza & Lane, 1994). Central to the theme of source monitoring is that this identification is not achieved via an abstract tag which is stored alongside the memory itself. Rather, it is proposed that information relating to the temporal, spatial and contextual circumstances in which a memory was acquired are an inherent feature of the memory itself. During the act of retrieval, evaluation criteria are then used to determine the source of the memory. These decision making processes are by no means arbitrary. That is, the evaluation criteria used to determine a memory's source will vary according to the nature of the memory task. The distinction made between *automatic* (e.g., using qualitative characteristics from activated memories) and *controlled* (e.g., retrieving additional information for comparison with activated characteristics) processing (Jacoby & Dallas, 1981; Johnston & Raye, 1981; Shiffrin & Schneider, 1977), is one such

example of the many different operations brought to bear in order to locate memorial origin. Situational factors are an important determinant of the type of source monitoring criteria used (Johnston et al., 1993). This point is best illustrated by an example provided Johnston et al. (1993) " ... we expect people to be more careful [consult many memorial sources using both controlled and automatic processes] about the origin of information when they are testifying in court than when they are recounting events on a social occasion" (p. 5).

Source monitoring theory provided a new way of viewing the misinformation effect. From this perspective, inconsistent postevent information was believed to cause *source misattributions* (Johnston et al., 1993). In essence, this meant that misled participants did not accurately identify the source from they encountered the postevent/original items, which led them to believe they *saw* the postevent item, rather than actually *reading* it. In order to demonstrate this principle, Lindsay and Johnston (1989a) modified the three phase adopted used previous research designs. The modification consisted of presenting the postevent items first, and the original items second. That is, participants were required to read material prior to viewing slides. For participants in the misled condition, some items in the slide sequence contradicted what they had previously read. At the time of testing, participants were then exposed to a forced recognition test and required to indicate which items they had seen in the slides. Analysis revealed that participants in the misled condition were significantly more likely to report postevent items compared to the control group. As the inconsistent postevent information was introduced first, such findings provided suggestive evidence<sup>6</sup> that source misattributions were responsible for misinformation effects.

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<sup>6</sup>The Lindsay and Johnston (1989a) study can be said only to provide suggestive evidence, as the principles of non-retention/deliberation can still be applied to account for such results. However, subsequent results concerned with the efficacy of the 'source monitoring test' argue against this conclusion as they can not be explained

As has already been discussed, a claim central to source monitoring theory, is that the criteria an individual uses to identify a memory's origin, can influence source judgements. Forced choice recognition tests which require participants to choose between items that were visually presented (i.e., via slides) and items which were previously not encountered (i.e., the distracter slides) have been demonstrated to cause participants to base their source monitoring decisions upon familiarity (Jacoby & Dallas, 1981; Mandler, 1980). Bearing this principle in mind, the standard test used by previous researchers (e.g., Bekerian & Bowers, 1983; Loftus et al., 1978) represents a difficult task for misled participants, as several factors (e.g., recency, salience) may cause these individuals to favour the postevent alternative. On the other hand, misled participants who encounter a modified test would not be subject to such difficulties, as even if they do not remember what they saw (i.e., the original item), they certainly are unlikely to select an item they have not previously been exposed to (i.e., the novel item) (Belli, 1989; Johnston et al., 1993; Tversky & Tuchin, 1989; Zaragoza & McCloskey, 1989). Thus, the source monitoring account does not attribute misinformation effects to response biases (i.e., McCloskey & Zaragoza, 1985), rather this explanation focuses upon the criteria used to evaluate memories. Furthermore, these criteria are believed to be influenced by the circumstances surrounding retrieval.

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by the principles of non retention/deliberation. As will be discussed later, the two explanations (i.e., source monitoring and misinformation acceptance) need not be considered as being mutually exclusive- indeed one of the claims made by the source monitoring perspective is that additional knowledge outside of that contained within the memory itself can also inform source monitoring decisions (e.g., 'It could not have been Elvis I remember seeing yesterday, as he has been dead for over two decades'). From this perspective, the process of deliberation can be viewed as legitimate.



These claims led researchers (e.g., Zaragoza & Lane, 1994) to predict that testing conditions which increased the salience of source monitoring characteristics would result in fewer misled-control differences compared to tests which required participants to rely upon a familiarity criterion. In order to test this prediction, Lindsay and Johnston (1989b) employed the three phase paradigm. The essential difference with this study was that half of the participants received a recognition test which required them to indicate whether they had seen the item during the initial slide phase (the standard test), whereas the other half were expected to identify the source of any item they believed they had witnessed before (the source monitoring test). A misinformation effect was only detected amongst the conditions which received the recognition test. When source monitoring decisions were encouraged, misled participants correctly categorised postevent items as coming from a written source. These results have subsequently been replicated by Zaragoza and Koshminder (1989). Such findings clearly support the notion that the criteria adopted at the time of testing can influence the accuracy of participants' memories.

The discovery that source monitoring tests could boost memory performance led Lindsay (1990) to investigate the effects that external conditions would have upon source monitoring decisions. Participants within this study were assigned to one of two groups: the *easy source monitoring* condition or the *difficult source monitoring* condition. Those in the easy condition received inconsistent postevent information two days after viewing the slides, minutes before the test, and under conditions that differed from those under which they had viewed the slides. The difficult condition received their postevent information under very similar conditions as well as just minutes after viewing the slides (i.e., two days prior to testing). Prior to the final recall test, participants received 'logic of opposition' instructions, that is, they were informed that details given in the postevent narrative were inaccurate, and should not be recalled. It was reasoned that this warning would cause participants to involve source monitoring criteria amongst their memory decisions. Results indicated that most participants in the easy

condition avoided reporting details mentioned in the postevent narrative. The difficult condition quite often reported these details. These results illustrate that source misattributions increase as a function of the similarities between contexts under which original and postevent memories are acquired.

### Integrating The Research

Opinion regarding the mechanisms underlying misinformation effects remains divided. Some researchers have attributed this effect to memory impairment, which is proposed to be either storage (alteration) (Loftus & Loftus, 1980; Loftus et al., 1978) or retrieval (coexistence) based. Another alternative, the misinformation acceptance hypothesis, postulates that poorer misled performance caused by demand characteristics and/or non retention of the original item. Finally, the source monitoring account implicates source misattributions as being the cause of misinformation effects.

The majority of the research concerned with the various theories has attempted to establish one particular theory's claims as the sole determinant of misinformation effects. However, a study conducted by Belli et al. (1994) illustrated an important point. This study was identical to the traditional three phase procedure, except for two details. The first difference involved the type of test used during the third phase. Instead of the usual forced recognition procedure, Belli et al. (1994) required their participants to recall both details which were depicted in the slides (consistent), as well as any inconstant details they may have remembered (inconsistent). Secondly, in order to avoid response biases, participants were warned that the postevent narrative contained some inconsistent details<sup>7</sup>. When both the consistent and inconsistent responses were analysed together, it was revealed that original items which were contradicted during the postevent phase were significantly

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<sup>7</sup> The Belli et al. (1994) postevent manipulation served as a within-subjects independent variable, with each participant receiving misled and control items on the postevent narrative.

less likely to be recalled than those that were not. Analysis regarding participants' memory for source indicated that many participants reported seeing the postevent item (i.e. placed in the consistent column), whilst of those who did recall the original item (they were misled upon), many also reported reading this item (i.e., inconsistent column). These findings suggest that both memory impairment (indicated by fewer overall items being recalled), and source misattribution (indicated by participants incorrect source responses) influenced misled-control differences.

The above example is significant in that it suggests that no one theory can completely account for misinformation effects. The Belli et al. (1994) research indicated that both memory impairment and source misattributions contributed to poorer misled performance, however, the principles of misinformation acceptance may also operate in conjunction with these processes. Whilst it is possible that poorer misled performance may be due to the postevent item either interfering with the original item (memory impairment), or being mistaken for the original item itself (source monitoring), additional effects may be caused by individuals simply not remembering the information and assuming the postevent item is correct (non retention)<sup>8</sup>. Furthermore, some individuals may clearly remember both the original and postevent items, be clear regarding their source and yet still report

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<sup>8</sup>As already discussed the modified test has been proposed to be insensitive to memory impairment (Belli, 1989; Tversky & Tuchin, 1989). Such a test also eliminates non retention and deliberation (McCloskey & Zaragoza, 1985), as well as making source monitoring judgements much more easy (Belli, 1989; Tversky & Tuchin, 1989). Thus, whilst such a procedure eliminates misinformation effects, it does not mean processes such as impairment, deliberation and non retention are not important. It merely illustrates that under some conditions, (i.e., when the postevent alternative is not made salient), such effects can be avoided.

seeing the postevent item (deliberation). Thus, in any given experiment, a misinformation effect may be due to each of these processes. The proportion of participants who experience each of these process will vary across studies according to numerous factors including the type of test (e.g., modified test, source monitoring) procedure, the proportion of suggestible participants (i.e., those who will acquiesce to demand characteristics) and the type of material which needs to be encoded (i.e., less people will be subject to non retention, although not necessarily impairment and source misattribution when material is more easily encoded).

The universal acceptance of one particular theory is unlikely to occur (Gee, 1994). Evidence is subject to multiple interpretations (Belli, 1989), or suggests several different processes operate at the same time (Belli et al., 1994). This suggests that the misinformation effect is a complex mechanism, which is subject to a variety of processes. Bearing this in mind, perhaps the greatest task confronting contemporary researchers will not be establishing which theory deserves precedence, but rather integrating the vast body of research already concerned with the misinformation effect.

## Chapter 2: An Unresolved Issue: The Effect of Sequential Test Presentation

As was discussed in the previous chapter, the majority of the misinformation effect findings are subject to multiple interpretations (Belli, 1989). However, one set of findings which remains unresolved involves the contradictory research (i.e., Bekerian & Bowers, 1983 vs. McCloskey & Zaragoza, 1985) regarding the effects of sequential test presentation. Discussion of these conflicting results and their theoretical implications is conducted below.

### Sequential Test Order: Conflicting Results, Effects and 'Anomalies'

Failure to detect a significant misled-control difference using the modified test procedure led McCloskey and Zaragoza (1985; Zaragoza & McCloskey, 1989; Zaragoza et al., 1987) to reject the memory impairment hypothesis in favour of their alternative, the misinformation acceptance hypothesis. Prior to criticisms which emerged after the publication of their initial paper, McCloskey and Zaragoza (1985) certainly presented a strong case. One convincing aspect of their hypothesis was that it was able to account for much of the previous research which had been concerned with determining which of the two memory impairment hypotheses (i.e., alteration, coexistence) were correct. In fact, McCloskey and Zaragoza (1985) went into considerable detail in applying their results to account for previous detail (e.g., Christiaansen & Ochalek, 1983; Greene et al., 1982; Loftus et al., 1978; Weinberg et al., 1983).

One finding they could not directly account for was Bekerian and Bowers' (1983) research. As noted in the previous chapter, Bekerian and Bowers (1983) found that by testing their participants in sequential order, the deleterious effects of misinformation were avoided. Such findings are clearly inconsistent with McCloskey and Zaragoza's (1985) position that misinformation effects are caused exclusively by processes related to misinformation acceptance. After all, it seems unreasonable to

assume that differential guessing and demand characteristics would decrease as a function of sequential presentation. This fact was acknowledged by McCloskey and Zaragoza (1985) themselves:

Bekerian and Bowers used the original test procedure; for the critical test question, the alternatives were the originally seen item and the item presented to misled subjects as misleading information. As we have pointed out, when the original test procedure is used, poorer misled than control performance is expected even if misleading information has no effect on the subjects' ability to remember (i.e., access) the original information. This prediction applies to sequential as well as random tests (p. 13).

This led McCloskey and Zaragoza (1985, Pilot Experiment) to attempt to replicate Bekerian and Bowers' (1983) research. Like their predecessors, McCloskey and Zaragoza (1985) split their sample between two test conditions: random and sequential. Both conditions were exposed to the standard test procedure. In addition to this, McCloskey and Zaragoza (1985) went to greater lengths in order to reinstate the initial encoding context. Whereas Bekerian and Bowers' (1983) sequential group received only the test pairs (i.e., critical and non-critical) during the final phase, those in McCloskey and Zaragoza's (1985) sequential cell received the entire slide sequence (i.e., test pairs, as well as single slides that were not being tested). Despite this additional feature McCloskey and Zaragoza (1985) failed to find an effect of test order. Instead both the random and sequential conditions displayed significant misled-control differences. This finding, coupled with McCloskey and Zaragoza's (1985) findings regarding their use of the modified test procedure led these researchers to label Bekerian and Bowers' (1983) findings as "anomalous"(p. 14).

Bekerian and Bowers' (1983) results were significant in that they supported the notion that misinformation effects were due to accessibility based impairment.

Bearing in mind that subsequent researchers (Belli, 1989; Tversky & Tuchin, 1989) have criticised the modified test procedure as being insensitive to such kinds of memory impairment<sup>9</sup>, McCloskey and Zaragoza's (1985) dismissal of Bekerian and Bowers' (1983) results appears somewhat premature. Given the theoretical implications of these effects, it is somewhat surprising that subsequent research has not endeavoured to identify a more systematic explanation for the conflicting results reported by the two groups of researchers. In fact, McCloskey and Zaragoza's (1985) paper represents the most recent explanation of the association between test order and misinformation effects available amongst the published literature. As such, research concerned with investigating the source of this discrepancy is long overdue.

#### A Possible Resolution

Numerous studies have suggested that events which have logically progressing themes (i.e., causal links between actions) and central items (i.e., items important to the meaning conveyed in the slides) are more likely to be remembered than events which lack these features (Black & Bower, 1979; Haberlandt, Berian & Sanderson, 1981; Murachver, Pipe, Gordon, Owens & Fivush, 1996). Therefore, an alternative explanation for these conflicting results could lie in the respective studies' use of stimuli which possess different amounts of thematic content. Bekerian and Bowers' (1983) slides depict an event which has both a clearly progressing or *linear* theme (e.g., car approaches an intersection, car stops, car runs over someone). Conversely, it is not so clear as to whether McCloskey and Zaragoza's (1985) slides possess these features, as the actions depicted during their scenes are somewhat arbitrary, with the burglar's movements throughout the scene having no real logical sequence. The term *non linear* is applied to slides which possess this feature.

According to Bekerian and Bowers (1983) slide linearity is essential, as it is the reinstatement of the theme created by sequential test presentation which acts as a

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<sup>9</sup> These criticisms have already been discussed in detail, in the previous chapter.

retrieval cue, hence the decrease in misled-control differences amongst this condition.

Extracting thematic information will ensure that the slide series is perceived and understood as a coherent, intelligible story. Thus, the sequential nature of the slides provides important global information that would be encoded along with the finer details in the individual slides. If the slides were then presented in a random order at test, the thematic cues would not be explicit in the retrieval environment. This could have the effect of forcing subjects to use a retrieval strategy that will not be optimal for accessing the original memory (p. 140).

As it is not clear if McCloskey and Zaragoza's (1985) slides shared this feature, it is quite possible that the absence of thematic information was the reason behind McCloskey and Zaragoza (1985) obtaining results which were antagonistic to those reported by Bekerian and Bowers (1983). Put simply, whereas Bekerian and Bowers' (1983) participants encountered slides which allowed them to encode material thematically, and thus benefit from thematic presentation, McCloskey and Zaragoza's (1985) slides lacked this feature. As such, McCloskey and Zaragoza's (1985) participants would not have encoded material in a manner which was conducive to sequential testing.

The present study was designed to examine the possibility that differing levels of thematic contact mediated the effect of sequential testing and hence resulted in the conflicting results reported in previous research (i.e. Bekerian & Bowers, 1983; McCloskey & Zaragoza, 1985). In order to test this hypothesis a procedure in which participants were exposed to (a) both consistent and inconsistent postevent information (b) either random or sequential testing, and (c) differing levels of thematic content (i.e., linear vs. non linear) needed to be developed. Whilst the first two of these objectives (i.e., postevent information, test presentation) was achieved easily enough, the manipulation of thematic content required innovation. It was



decided that this effect could be produced by presenting the Bekerian and Bowers (1983) in random order during the first phase of the experiment. The random presentation would eliminate the thematic cues present amongst these slides, thereby creating the non-linear effect required for this experiment. Thus, thematic content was manipulated by the order slides were presented in during the initial phase. These were presented either sequentially (linear) or randomly (non linear).

A weakness inherent in employing Bekerian and Bowers' (1983) slides exclusively throughout all conditions, was that the thematic content of McCloskey and Zaragoza's (1985) slides would not be directly evaluated. Therefore, if the effects of linear/non linear presentation were found to interact with test presentation, it could be argued that such a result represented only suggestive evidence for the proposition that McCloskey and Zaragoza's (1985) stimulus materials were the cause of their null results. That is, as McCloskey and Zaragoza's (1985) slides were not used, it could be claimed the linearity of these slides had not been established. However, it is the author's opinion that this disadvantage was outweighed by the advantage of such a procedure, as using McCloskey and Zaragoza's (1985) slides may have confounded results. Bekerian and Bowers (1983) slides sequence consisted of 25 slides. McCloskey and Zaragoza (1985) on the other hand, used a sequence of 79 slides. Had both sets of slides been used, it could have been argued that failure to find an interaction between slide type and test presentation may have reflected the two slide groups (linear vs, non linear) having to encode different amounts of material. This effect could not be avoided by shortening the McCloskey and Zaragoza (1985) slides, as removing slides would then alter the stimulus materials, thereby making general conclusions difficult. By exposing all of the conditions to Bekerian and Bowers' (1983) slides this confound was eliminated from the study. Thus, if McCloskey and Zaragoza's (1985) slides had been used, a difference found between the two slide types could only be interpreted to mean that some general aspect of the slide conditions (e.g., different amounts of slides) affected this result. By using Bekerian

and Bowers' (1983) slides exclusively, the affect of linearity was able to be manipulated directly, thereby avoiding this criticism.

During this chapter, the reader has been exposed to various explanations regarding the effects of sequential testing. By evaluating the effect that misinformation has upon participants exposed both to varying levels of thematic content (linear vs non linear) and test presentation order (sequential vs random), each of these hypotheses could be tested. The first hypothesis was provided by Bekerian and Bowers (1983). A simple application of their findings would predict an interaction between presentation order and misled-control performance<sup>10</sup>, that is, misinformation effects will be absent from sequential test conditions, irrespective of slide linearity. McCloskey and Zaragoza (1985) proposed that sequential test effects were negligible. If McCloskey and Zaragoza's (1985) conclusion was correct, only differences between misled and control performance should be found. From this perspective, misinformation effects will occur across all conditions, regardless of slide linearity or test presentation. An alternative to this conclusion is the experimental hypothesis which will be tested for the first time in the present experiment. This proposes that the effects of sequential testing are contingent upon the linearity of the slides used by researchers. If the experimental hypothesis is correct, it would be expected that an interaction between misled-control performance, slide type and test presentation order would be found.

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<sup>10</sup> Given the more recent findings reported by McCloskey and Zaragoza (1985), this pattern of results does not appear as probable as those predicted by either the experimental hypothesis, or McCloskey and Zaragoza (1985) themselves.

# Chapter 3: Method

## Research Design

Participants were exposed to three independent variables during this study. The first of these involved the type of slides participants were exposed to during the initial encoding stage (i.e., phase 1). Half the participants received their slides in sequential order (the linear group) whereas the other half received their slides in random order. The second variable involved the type of test presentation. Once again this manipulation was split equally amongst the sample, half were tested in sequential order (the sequential group); the other half were tested in random order (the random order). The combination of these two variables created four cells: linear-sequential, linear-random, non linear-sequential, non linear random.

The third independent variable involved exposure to postevent information. This served as a within-subjects variable, with each participant being exposed to a control item, as well as a misled item. The dependent variable was based upon participants' correct responses upon the recognition test.

## Participants

The sample consisted of 112 adults. Of this sample, 38 were university students. The remaining 74, were members of the public who were recruited through various community services (e.g., slimming clubs), sporting associations, and social networks. Participants were tested in groups of one, three, four, five, six, 12 and 16. Whilst every attempt was made to ensure that participants were randomly assigned to the four respective cells, in the interests having equal numbers within each cell, the group numbers often dictated which cell they were allocated. For example, if one condition required a group of three to compete it, and these exact numbers were present, they were placed in this cell. Thus, the procedure regarding group assignment is probably best described as being 'quasi random'.

### Apparatus

Two slide projectors and related equipment (e.g., interval timer, infra red remotes, slide carousels), a set of slides and test booklets were used during the experiment.

Slides The set of slides consisted of 25 slides, which depict a traffic accident. During the slide sequence, two pedestrians are seen walking along a footpath. Upon attempting to cross the road one of these pedestrians is struck by a red Datsun. In the ensuing scene, the driver of the Datsun emerges from the car, a police car arrives, and the driver of the Datsun can be observed fleeing the scene.

Included within these slides are a set of test slides which include alternative versions of the same event. These test slides can be split into two categories: the critical item pair, and the non critical pairs. The difference between these two categories involved whether they were discussed during the postevent manipulation. The critical item was referred to during this phase, whereas the non critical pairs were not. Whilst the inclusion of the critical item should by now be apparent (i.e., it is the means by which misinformation effects are measured), the purpose of the non critical items was less clear cut. Essentially, they were included in order to serve as distracter pairs. That is, it was reasoned that by embedding the critical items amongst these other test pairs, participants would be less likely to realise the importance of this particular item, and therefore would be less likely to succumb to demand characteristics.

Essentially, the slides used for this study were identical to those used by Bekerian and Bowers (1983). However, for the purposes of this investigation, it was deemed necessary to alter several features of these slides. The first difference related to the critical item. This particular item involved a road sign at an intersection (Slide 10), with the two possible alternatives being either a *stop* or *giveaway* sign. Unlike Bekerian and Bowers (1983) during which misled-control differences were assessed between-subjects, this study treated the postevent item as a within-subjects variable. Hence, the creation of a second critical item was deemed

necessary. During the accident in depicted in the slides, an observer in a green Ford can be seen driving past during two of the slides. The color of this car was changed via computer manipulation to yellow (slide 18). This formed the basis of the second critical item, with their now being two alternatives: *yellow car* and *green car*. The manipulation of the car's color was expected to be an effective vehicle for misinformation, as previous studies reported significant misled-control differences when critical item alternatives were distinguished by color (Loftus et al., 1978; Tousignant, Hall & Loftus, 1986). Computer manipulation was then used to remove this car from the second slide it appeared in (slide 19), to ensure that participants were given only one chance to encode<sup>11</sup> this item.

The second difference related to the non critical pairs. Unfortunately, the set of slides obtained for this study did not include the non critical items. Thus, further computer manipulation of the slides was required in order to produce them. These modifications involved the removal of the companion's watch (slide five), a no parking sign (slide nine), the companion as she leant upon a light pole (slide 12), as well as the removal of bore tap connection (slide 21). The final pair was created by adding a poster onto a building which appeared in the background of one of the slides (slide six).

Test booklet The test booklet consisted of eight pages, which can be viewed in Appendix A. The first of these pages contained issues regarding informed consent. The following two pages contained the first of two filler tasks. The fourth and fifth pages formed the basis of the postevent manipulation, consisting of a series of 20 questions which related to the slides participants had seen. The control-misled questions occurred at number 13 and 17. Question 13 related to the car critical item, whereas question 17 related to the road sign. Participants who received the car as a control

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<sup>11</sup> It was necessary to guarantee that the car critical item only appeared once in the slide sequence, as two exposures to the same item may have made participant's memories more resistant to inconsistent postevent information.

item were asked 'Was there anyone leaning out of the car that passed the accident scene?'. This question was essentially the same for participants who were misled upon this item, except that the color opposite to that which was depicted in the slides was inserted in front of the word 'car' (e.g., for those who saw a yellow car, the word 'green' appeared in the question). Participants who served as controls on the road sign item were asked 'Did a pedestrian<sup>12</sup> walk in front of the red Datsun when it was stopped at the road sign?'. Those who were misled upon this item received the same question, except that the term 'road sign' was replaced by the item opposite to that of which they had seen during the slide sequence (e.g., if they saw a stop sign, the word 'giveaway sign' replaced the word 'road sign' in the questionnaire). It is worth noting that in both question 13 and 17, inconsistent information was peripheral to the answer. That is, participants were not asked directly about which color car or road sign they viewed. Work conducted by Loftus (1979a) suggested that items which allowed participants to actively scrutinise the inconsistent postevent information resulted in negligible misled-control differences. It is for this reason that questions 13 and 17 were designed in this manner.

The sixth and seventh pages contained the second filler task. The final page was included to allow participants to record their responses upon the final recognition task. This form consisted of two columns ('Left' and 'Right'), and five rows. The rows corresponded to the five test pairs, whilst the columns related to the two alternatives for each of test pair.

### Procedure

The procedure employed during this study followed the basic outline of the three phase paradigm originally utilised by Loftus et al. (1978). During the first phase participants were seated and given instructions, and then exposed to the slide

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<sup>12</sup>For the duration of this study, the pedestrian who avoided being struck by the car is referred to as the companion, whereas the person who was struck is referred to as the pedestrian.

sequence. Instructions informed participants that the experiment was concerned with 'visual and verbal intuitions about memory', as well as communicating the need for participants to pay strict attention. It was also explained that the slides were made in the United States, and as such vehicles would appear on the right hand side of the road. As has already been discussed, participants in the linear condition received their slides in sequential order. Those in the non linear condition viewed a random sequence. The critical items participants received during this phase were split equally amongst each cell; half viewed a stop sign and green car, whereas the other half were exposed to a giveaway sign and yellow car. Slide images appeared on the left hand side of the projector screen, and were presented at a rate of four seconds.

After completing this task, participants attempted the first filler task. After spending 10 minutes attempting the filler tasks, participants moved on to the 20 item questionnaire (phase two). The road sign and cars served equal amounts of time as control and misled items. That is, half of the participants in each cell were misled upon the car item, and received neutral information for the road sign, whereas this process was reversed for the other half. Upon finishing these questions participants then carried out another 10 minute filler task, after which they progressed the forced recognition test (phase 3). During this phase participants the 25 slide sequence was presented via the left overhead projector again. For 7 of these slides, an accompanying slide was presented from the right hand side (i.e., the five non critical and two critical items). The sequential conditions had their 18 single slides and 7 test pairs presented sequentially. Those in the random conditions received the 18 slides and 7 test slides in random order. With respect to the critical items a standard test procedure was used, that is, the item suggested during the postevent manipulation was included as an alternative to the original item. For each of these seven pairs participants were instructed ascertain which of these alternatives they had previously seen and mark this in the corresponding column (i.e., Left or Right). The correct slides (i.e., those seen during phase one) were distributed randomly to either the Left or Right hand sides. Prior to the test commencing, participants were

informed that if they could not remember which of the two test pairs they saw, they were required to guess. After completing this test phase, participants were debriefed.



# Chapter 4: Results

## Scoring

Three aspects of the final test phase were scored in order to allow further analysis. The first two aspects were related to the participants' recognition performance for the two critical items. These formed two separate categories, misled performance and control performance. A score of one was assigned to correct responses, whereas incorrect responses were given a score of zero. The final aspect that was scored involved participants' performance upon the five non-critical item test pairs. The amount of correct responses was divided by five, in order to yield a proportion correct score.

## Screening

Prior to the analysis, misled item performance, control item performance and non-critical item performance were examined using SPSS For Windows for accuracy of data entry and missing data. Analysis confirmed that there were no missing values, so all 112 participants' responses were included within the analysis. Whilst misled and control performance were discrete variables, the non critical item performance consisted of interval data. As such, participants' non critical item performance were screened regarding the assumptions of normality and homogeneity of variance. A check of both the stem and leaf plots and skewness and kurtosis values (i.e., -.082 and .011 respectively) combined with the results from the Kalmogorov-Smirnov test,  $D(112) = .227$ ,  $p = .000$ , revealed that the distribution of scores were moderately skewed in a negative direction. An attempt to transform the data using the square root transformation option on SPSS For Windows, resulted in the non critical scores becoming positively skewed (i.e., the skewness and kurtosis values were .024 and -.036 respectively,  $D(112) = .231$ ,  $p = .000$ ). As the homogeneity of variance was satisfied,  $F(3, 112) = 1.024$ ,  $p = .385$ , and cell sizes were equal, it was decided to analyse the untransformed non critical data.

## Analysis

Overall Analysis of Misled and control item performance Participants' critical item performance scores was analysed by both a split plot Analysis of Variance and loglinear analysis. As the use of an ANOVA upon dichotomous data is controversial, and the results from both of these analyses were essentially the same, only the loglinear analysis is discussed in this section. The results from the ANOVA are discussed in Appendix B.

Participants' misled and control item performance represented discrete variables and as such parametric tests could not be used to analyse this data. Loglinear analysis was an alternative technique which allowed relationships between the type of slides (i.e., linear, non-linear), test order (sequential, random) and misled-control recognition performance to be assessed. In order for these relationships to be analysed, it was necessary to collapse misled item performance and control item into one between-subjects variable<sup>13</sup>. During this procedure, a new scoring criteria had to be developed. This involved calculating a difference score to represent control and misled item performance. Participants who were correct for the misled item and incorrect upon the control item were given a score of negative one. Conversely, those who were correct for the control item yet incorrect on the misled item were given a score of one. Participants who were either correct or incorrect on both the misled and control items were given a score of zero. Descriptive statistics for the four cells' misled item performance, control item performance and the new variable, recognition difference, are provided in Table 1.

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<sup>13</sup>Unlike the Analysis of Variance (ANOVA), log linear analysis can not analyse within-subjects data (Tabachnick & Fidell, 1996). As misled and control performance was obtained via repeated measures, it was necessary to collapse these two variables so that they resembled between-subjects data.

Table 1

Descriptive Statistics Regarding Performance on Misled and Control Items, And Mean Difference Between These Two Scores

Group	<u>Control Item</u>		<u>Misled Item</u>		<u>Difference</u>	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Non-linear-Random	.75	.44	.54	.51	.21	.57
Non-linear-Sequential	.64	.49	.54	.51	.11	.68
Linear-Random	.68	.48	.39	.50	.29	.66
Linear-Sequential	.71	.46	.50	.51	.21	.63

Note:  $n = 28$

The means displayed in Table 1 indicate that the difference between these two scores in each of the four cells were consistent with previous misinformation research (i.e., misled performance is worse than that on control items). It is also interesting to note that, contrary to the experimental hypothesis, participants in the non-linear conditions tend to have performed better than their linear counterparts in terms of misled item performance.

Using the SPSS LOGLINEAR program, a stepwise loglinear analysis with backward elimination was requested. The objective of such analysis is to develop a model which can provide the best description of the data, whilst using the simplest combination of variables to do so. The selection of variables for this model involves the systematic testing of components in order to remove any which do not significantly contribute to the model's explanation of the variance. The end result is a model which is as simple as possible whilst still adequately fitting the data (Farnhill, 1993; Norusis, 1990; Tabachnick & Fidell, 1996).

The three categorical variables analysed by this model were slide type (S), test presentation (T), and recognition difference (D). The data are shown in a 2 x 2

x 3 cross-classification table (see Table 2). As mentioned above, the model selection process involves comparing orders of complexity until the simplest model is found. Any model which retains higher order effects by necessity implies that lower order effects are also involved, although some of these lower order effects do not have to be themselves significant (Farnill, 1993). During the present analysis there were three levels of complexity, the main effects, the two way interactions and the threeway interaction .

Table 2

Cross Classification of the Frequencies of Recognition Difference Scores At Each Level of the Slide Type and Test presentation Variables

Slide Type	Control Worse ( - 1 )	No Difference ( 0 )	Misled Worse ( 1 )
Non linear			
Random	2	6	14
Sequential	2	8	12
Linear			
Random	2	4	16
Sequential	2	8	12

In the third order model, the effects tested that were included were all the possible threeway and two way interactions., as well as the main effects

$$\ln E = \theta + \lambda_S + \lambda_T + \lambda_D + \lambda_{ST} + \lambda_{SD} + \lambda_{TD} + \lambda_{STD}$$

This third order model was compared with the second order model, which omitted the three way interaction,

$$\ln E = \theta + \lambda_S + \lambda_T + \lambda_D + \lambda_{ST} + \lambda_{SD} + \lambda_{TD}$$

The change in fit statistic, the likelihood-ratio change chi square statistic was not significant,  $\chi^2(2) = 1.108$ ,  $p = .575$ . Thus, the threeway interaction did not make a

meaningful contribution to the model's predictive ability. The next step of the analysis involved comparing a model which had each of the two way interactions, with a model which included only some of these two way interactions. Removal of the interaction between slide and test did not significantly reduce the model's adequacy of fit,  $\chi^2(2) = .001$ ,  $p = .969$ . Removal of this association made intuitive sense, as the distribution of the slide type and test presentation variables was determined by the experimenter assigning participants to these conditions. Thus, the new model consisted of the following effects

$$\ln E = \theta + \lambda_S + \lambda_T + \lambda_D + \lambda_{TD} + \lambda_{SD}$$

This model was then compared with the model in which the interaction between slide type and recognition difference was deleted

$$\ln E = \theta + \lambda_S + \lambda_T + \lambda_D + \lambda_{TD}$$

Once again, this did not reduce the model's accuracy,  $\chi^2(2) = .665$ ,  $p = .717$ . The next comparison involved the removal of the main effect of slide type. This resulted in the following model

$$\ln E = \theta + \lambda_T + \lambda_D + \lambda_{TD}$$

The removal of slide type did not reduce the model's predictive ability,  $\chi^2(1) = .000$ ,  $p = 1.000$ . This model was then compared with the model in which the interaction between test presentation and recognition difference was removed

$$\ln E = \theta + \lambda_T + \lambda_D$$

The likelihood-ratio chi square test was not significant,  $\chi^2(2) = .826$ ,  $p = .662$ , indicating that the removal of the interaction between test presentation and slide type did not contribute to the model's predictive qualities.

The next comparison involved the deletion of the test presentation variable

$$\ln E = \theta + \lambda_D$$

The removal of test presentation did not reduce the model's predictive ability,  $\chi^2(1) = .000$ ,  $p = 1.000$ . The final step involved comparing the model in which the main effect of difference was kept in the model against the zero order model.

$$\ln E = \theta$$

The likelihood-ratio change statistic was significant,  $\chi^2(2) = 35.882, p = .000$ , indicating that deletion of the variable, recognition difference, would result in a loss of the model's predictive ability. The model had a likelihood ratio of  $\chi^2(9) = 2.600, p = .978$ , indicating a good fit between the observed and expected frequencies. Both the parameter estimates and  $z$  scores for the three way, two way and main effects are provided in Table C1 (see Appendix C). It is worth noting that SPSS LOGLINEAR reports parameter estimates by single degrees of freedom (Norusis, 1990; Tabachnick & Fidell, 1996). As such, there are  $(k-1)$  parameters for the main effects,  $(k-1) (k-1)$  parameters for the two way interactions and  $(k-1) (k-1) (k-1)$  parameters for the three way interactions. This means that the last category for each variable is redundant, and therefore not included within the SPSS output.

The loglinear analysis demonstrated that the only variable required to produce a model which could account for the observed frequencies was recognition difference. The other two main effects, slide type and test presentation did not significantly enhance the model's predictive capabilities. Furthermore, none of the three way or two way interactions added significantly to the model's predictive power. As can be seen in Table 2, there was over representation of the 'misled worse' (1) scores in each of the four cells. Such scores are indicative of a misinformation effect.

Specific Analysis of Misled and Control Item Performance Despite the non significant three way interaction, it was decided to conduct specific comparisons amongst the four cell means. Whilst conducting comparisons without a significant interaction effect is contentious, Howell (1997) has noted that such a result is not required in order to conduct post hoc comparisons. Howell's (1997) rationale for adopting such a position is twofold. Firstly, omnibus tests tend to distribute between-groups variance, making the detection of specific effects more difficult. Secondly, post hoc tests were designed without any concern for the statistical techniques which test for omnibus significance. As such, Howell (1997) has questioned the rationale of relying upon significant omnibus test results to justify

post hoc comparisons "If you accept the position that typical multiple-comparison procedures do not require significant overall  $F$ , then you will examine group differences regardless of the value of that  $F$ . Why, then, do we even need that  $F$ , except to provide a sense of closure? The only reason I can think of is 'tradition', and that is a powerful force" (p. 351). This argument provided the rationale for specific comparisons to be conducted, as it was decided that a separate examination regarding the magnitude of misled-control differences within each the four cells (i.e., recognition difference) would allow the effects of test presentation and slide type to be tested more specifically.

Using SPSS For Windows, one sample  $t$  tests were conducted on each of the four cells' recognition difference scores. The test value was set at zero. Recognition difference was significantly higher than zero in the linear-random cell,  $t(27) = 2.295$ ,  $p = .030$ . Recognition difference in the linear-sequential,  $t(27) = 1.800$ ,  $p = .083$ ; non linear-sequential,  $t(27) = .827$ ,  $p = .415$ ; and non linear-random,  $t(27) = 1.996$ ,  $p = .056$  cells were not significantly greater than zero. However, as can be seen the non linear-random cell only just failed to approach significance. Using the formula outlined by Howell (1997), a power analysis was conducted. This analysis revealed that the test had a 72% chance<sup>14</sup> of detecting a moderate (0.5) effect (cf. Cohen, , 1990, 1992). As a check of the normality assumption revealed that the recognition difference scores were moderately skewed (i.e., the skewness and kurtosis values were -.191 and -.578 respectively,  $D(112) = .306$ ,  $p = .000$ ). It was for this reason that each of the four cells' misled and control scores

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<sup>14</sup> Cohen (1990, 1992) recommends power of around 80%. Whilst the present study did not achieve this level of power, it still was reasonably high. Indeed, when one considers that a power analysis conducted by Rossi, Rossi and Cotterill (in press, cited by Cohen, 1990) upon 142 published studies revealed that the median power amongst this group was worse than chance (.44), the level of power in this study appears remarkably high.

were analysed using the non parametric Wilcoxon Signed Ranks Test. These pattern of results were the same as the parametric test results. For a more detailed discussion of these results, the reader is directed to Appendix D<sup>15</sup>.

Non critical item performance The final set of data subjected to analysis were participants performance on each of the five non critical item pairs. Descriptive statistics of each of the four cells' performance are presented in Table 3. As can be seen in Table 1, non critical item performance was highest in the linear-sequential group, followed by the non linear-random, linear-random and non linear-sequential cells respectively.

Table 3

Participants' Non Critical Item Performance

Group	<u>Non Critical Item</u>	
	<u>M</u>	<u>SD</u>
Non linear-Random	.607	.207
Non linear-sequential	.586	.180
Linear-random	.600	.231
Linear-sequential	.693	.228

Note:  $n = 28$ .

<sup>15</sup> It is realised that by reporting the parametric test results in the main body rather than Appendix D the author has broken the precedent set in the reporting of the overall analyses (i.e., the non parametric, loglinear analysis, was reported in the main section, whilst the parametric test was reported in Appendix B). However, as the author was unable to find a formula that would allow the power of the non parametric tests to be conducted, it was decided to report the parametric tests in the main body.



Using SPSS For Windows, participants' non critical item scores were analysed using a 2 x 2 Factorial ANOVA. The independent variables were slide type and test presentation. Results indicated that there were no significant main effects, slide type,  $F(1, 112) = 1.552$ ,  $p = .216$ ; test presentation,  $F(1, 112) = .792$ ,  $p = .376$ . In addition to this, there interaction between slide type and test presentation was not significant,  $F(1, 112) = 2.027$ ,  $p = .157$ .

## Chapter 5: Discussion

During the present study there were three hypotheses, the experimental hypothesis, the misinformation acceptance hypothesis (McCloskey & Zaragoza, 1985) as well as the explanation formulated by Bekerian and Bowers (1983). Each of these hypotheses made different predictions regarding the pattern of results that would be obtained during this study. The results obtained by the present study did not conform exactly to the predictions of any of these hypotheses. A description of the results is given below. A comparison of these results with the predictions made by each of the three hypotheses is also presented.

### Results From The Analyses

As the present study was concerned with ascertaining under which conditions misinformation effects would occur, analyses regarding participants' critical (i.e., misled and control) item performance were the main focus. In addition to this an analysis of participants' non critical item performance was also conducted. However, as this relates more to general memory performance than a misinformation effect per se (i.e., no postevent information regarding the non critical items was provided), it will be discussed later on in this chapter (see the section which discusses the experimental hypothesis). Participants' critical item performance was subjected to two types of analysis. The first of these was a loglinear analysis, during which a model of the significant associations between slide type, test presentation and recognition difference (i.e., misled item performance subtracted from misled item performance) was constructed using statistical criteria to eliminate effects which did not increase its predictive power. The second type of analysis consisted of a series of one sample  $t$  tests which were conducted upon each of the four cells' recognition difference scores. The distinguishing feature between these analyses was the amount of detail they covered. The loglinear analysis looked at all of the four cells' data together, and therefore provided an overall analysis of this data. The  $t$  tests, on the other hand, were much more specific, focusing upon the

effect each of the four combinations of slide type and test presentation had upon participants' recognition difference scores. As the results from the overall and specific analyses were not consistent (i.e., one set of results contradicted the other) with one another, both sets of results are discussed below.

Overall Analysis The loglinear analysis attempted to construct a model from the associations between slide type, test presentation and recognition difference. The purpose of this analysis was to provide a model with the simplest combination of effects, which still possessed sufficient explanatory power (Farnhill, 1993; Norusis, 1990; Tabachnick and Fidell, 1996). Non significant effects (i.e., main and interaction effects) which did not contribute to the model's predictive abilities were deleted from the model. In the present study, neither the three way interaction (slide type x test presentation x recognition difference) or any of the two way interactions (slide type x recognition difference; test presentation x recognition difference)<sup>16</sup> added significantly to the model's predictive abilities. Furthermore, out of the main effects, slide type and test presentation did not make a significant contribution to the model. Thus, the only effect which was found to be significant using loglinear analysis was the difference between participants' control and misled item performance (i.e., recognition difference). As the overall analysis suggested that recognition difference scores were unaffected by either slide type or test presentation, it was concluded that misinformation effects (i.e., poorer misled than control performance) were distributed equally throughout the four cells.

Specific Analysis In order to determine if the results from the loglinear analysis were reliable, a series of one sample  $t$  tests were conducted upon each of the four cells' recognition difference scores. The recognition difference scores were compared to a test value of zero, with scores which were higher than this value being

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<sup>16</sup> One other two way interaction, slide type and test presentation was also found to be non significant. However, as this relationship was based upon the assignment of participants to each of the four cells, it was not of theoretical interest.

interpreted as evidence of a misinformation effect. Based on the pattern of results obtained during the loglinear analysis, it was expected that each of the four cells would display misinformation effects. The descriptive statistics (see Table 1) indicated each of the four cells' scores were in a direction consistent with a misinformation effect (i.e., higher control than misled item performance). However, the results from the  $t$  tests indicated that only one of the cells, the linear-random group, displayed a misinformation effect. The other three cells (i.e., linear-sequential, non linear-sequential, non linear-random) did not display recognition difference scores which were significantly higher than zero, although in the non linear-random cell, this effect was only marginally non significant,  $t(27) = 1.996$ ,  $p = .056$ . The detection of a misinformation effect in only one of the cells was clearly inconsistent with the loglinear analysis, as this suggested participants' recognition difference scores were not equally distributed amongst the four cells. The following discussion now attempts to apply the results of these analyses to each of the three hypotheses.

#### McCloskey and Zaragoza (1985): Misinformation Effects Irrespective of Sequential Testing

McCloskey and Zaragoza's (1985) misinformation acceptance hypothesis argued against any form of memory impairment. Rather, these authors contended that response biases (i.e., deliberation, non retention) caused by the use of a test in which the postevent item was present (i.e., the standard test) were the processes underlying misinformation effects. Bekerian and Bowers' (1983; Bowers & Bekerian, 1984) findings indicated that participants who received sequential test presentation did not report a significant misled-control difference. Clearly, such findings were at odds with the misinformation acceptance hypothesis, as sequential testing could not have been expected to reduce response biases caused by non retention and demand deliberation. This was acknowledged by McCloskey and Zaragoza (1985) who claimed that "when the original test procedure is used, poorer misled than control performance is expected... This prediction applies to sequential

as well as random tests" (p. 13). To resolve this issue, McCloskey and Zaragoza (1985) replicated Bekerian and Bowers' (1983) study and found misinformation effects amongst both the random and *sequential* conditions. This led them to conclude that Bekerian and Bowers' (1983) results were "anomalous" (p. 13), as sequential presentation did not affect the influence of inconsistent postevent information.

In terms of the present study, the misinformation acceptance hypothesis would predict that each of the four cells would experience misinformation effects. From this perspective, neither sequential testing, or the factor expected to mediate this effect (i.e., slide linearity)<sup>17</sup> would have been expected to influence misinformation effects. The results of the loglinear analysis are certainly consistent with these predictions, as recognition difference was the only effect which contributed significantly to the model's predictive power. As none of the interactions were found to be significant, McCloskey and Zaragoza's (1985) prediction that participants exposed to a standard test (as was the case in the present study) would experience a misinformation effect, irrespective of test presentation, seems to have been supported. However, caution must be exercised in accepting this explanation, as the results from the specific analysis did not conform to this prediction. That is, the finding that a misinformation effect was restricted solely to the linear-random cell contradicts McCloskey and Zaragoza's (1985) position, as it suggests that misled-control differences were not spread uniformly throughout the sample.

As can be seen, a clear evaluation of McCloskey and Zaragoza's (1985) hypothesis was impeded by the two sets of conflicting results obtained during the present study. The overall analysis supported the misinformation acceptance hypothesis, whereas the specific analyses were at odds with the predictions made by this explanation. Therefore, the decision to accept or reject McCloskey and

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<sup>17</sup> The expectation that slide linearity would influence test presentation was in fact unique to the experimental hypothesis.

Zaragoza's (1985) hypothesis rested on determining which of these two sets of findings were the most appropriate basis for forming a conclusion.

As was discussed in the results section, the use of specific comparisons (i.e., one sample  $t$  tests) without a significant interaction effect is a controversial technique (Howell, 1997). However, Howell (1997) has attacked the logic of this argument by suggesting that as the tests used for specific comparisons were developed without the consideration of overall tests, this criticism is invalid. Howell (1997) went on to suggest that in some cases the reliance upon a significant overall result may be counter-productive, as in cases where effect sizes are small, overall tests may lack the specificity to detect significant effects. Bearing this in mind, the specific analyses possessed a distinct advantage. That is, by focusing upon each separate cell, a greater indication of the effects both slide type and test presentation had upon the magnitude of misled-control differences would be given. It was reasoned that as each of the cells represented one of the four possible combinations of slide type and test presentation, analysis which focused upon each of these separately would give a much more detailed account than an overall analysis which observed only general effects. Another argument in favour of the use of specific comparisons was that these were used by McCloskey and Zaragoza (1985) themselves. Rather than using an ANOVA (i.e., McCloskey and Zaragoza, 1985 used four critical items allowing the use of a parametric test) McCloskey and Zaragoza (1985) used two independent sample  $t$  tests<sup>18</sup>. These were used to compare misled and control item performance separately for both the random and sequential test conditions. Thus, the use of specific rather than overall analysis was not restricted to the present study.

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<sup>18</sup> As McCloskey and Zaragoza (1985) had both a larger sample (i.e., 168 participants) and fewer variables (test presentation x item type) than the present investigation, they had enough participants in each cell (i.e., 42) to compare misled and control performance directly. This was not the case with the present study (i.e., 28 per cell), hence the one sample  $t$  tests.

As the one sample  $t$  tests possessed better power, and were consistent with previous research (e.g., McCloskey & Zaragoza, 1985) it was decided to interpret these results rather than those provided by the overall analysis. This decision resulted in McCloskey and Zaragoza's (1985) conclusion being rejected, for as has already been discussed, this pattern of results was inconsistent with predictions made by these researchers.

#### The Experimental Hypothesis: Test Presentation Is Mediated By Slide Linearity

Unlike McCloskey and Zaragoza's (1985) hypothesis, the experimental hypothesis attributed misinformation effects to memory impairment which was believed to occur at the time of retrieval (cf. Bekerian & Bowers, 1983; Christiaansen & Ochalek, 1983). According to such *coexistence* accounts, the introduction of inconsistent postevent information creates an additional memory representation which reduces the accessibility of the original item. This results in participants selecting the postevent item at the time of testing. The notion that both the postevent and the original item could coexist in memory, led researchers (e.g., Belli, 1989; Christiaansen & Ochalek, 1983) to manipulate experimental conditions in an attempt to increase the accessibility, and hence the retrieval of the original memory. One particular condition that was believed to produce such an effect was that of sequential testing (Bekerian & Bowers, 1983; Bowers & Bekerian, 1984). It was reasoned that by testing participants in a sequential rather than random fashion (as had been the case with previous research), the testing conditions would match those present during the encoding of the original memory. This resulted in a reinstatement of the encoding context (Tulving & Thompson, 1973), which in turn led to the original item being more accessible. When random test presentation was used, the context present during encoding was not reinstated, hence the postevent item was more likely to be retrieved.

One barrier to the acceptance of this conclusion was that McCloskey and Zaragoza (1985) had failed to detect an effect of sequential testing. However, the fact that McCloskey and Zaragoza (1985) did not use the same stimulus materials as

Bekerian and Bowers (1983) may have influenced results. It was reasoned that thematic cues were required to be present amongst the slides, otherwise no effect of context reinstatement would occur. That is, thematic cues were believed to be the feature present during encoding that were reinstated during retrieval via sequential testing. From this perspective, the apparent lack of thematic content (i.e., non linearity) present amongst McCloskey and Zaragoza's (1985) slides would have resulted in sequential testing having a negligible effect. This possibility led to formulation of the experimental hypothesis which predicted an interaction between slide type, test presentation and item type. According to this hypothesis, the effect of sequential testing was expected only to become salient amongst conditions in which the initial encoding conditions provided global information which could be reinstated by sequential testing. If such conditions were not present during the time of encoding (i.e., the non linear conditions), there would be no benefit of sequential testing. In terms of the specific comparisons, as the linear-sequential group were the only participants who were exposed to conditions which allowed sequential testing to have an effect upon the retrieval of the original memory (i.e., linear slides), this was the only cell which was expected to display no significant difference between misled and control item performance. As the other three cells (i.e., linear-random, non linear-sequential, non linear-random) received conditions which were not conducive to the retrieval of the original item, they were expected to experience significant misinformation effects.

The results from the  $t$  tests produced a pattern which was not entirely consistent with these predictions. The results from the cells in the linear condition were congruent with predictions made by the experimental hypothesis. That is, a misinformation effect was found in the linear-random cell and was absent from the linear-sequential cell. However, in stark contrast to predictions made by this hypothesis, both of the non linear cells failed to display a misinformation effect, although in the case of the non linear-random cell this was only marginally the case. This finding could not be explained by the experimental hypothesis as the non linear



conditions were expected to experience misinformation effects (irrespective of the type of test presentation). A further irregularity found in the non linear condition was that the two non linear cells' mean recognition difference scores (see Table 1) were either equal to or superior to the linear-sequential cell (i.e., all three cells performed above chance). If the experimental hypothesis was correct, the scores in the non linear cells should have been equal to the linear-random (i.e., below chance) rather than the linear-sequential cell.

Failure to find misinformation effects amongst the non linear cells was clearly inconsistent with the experimental hypothesis. It could be suggested that the reason for these results was that the item type manipulation (i.e., neutral vs. inconsistent postevent information) did not work, which in turn resulted in a decreased tendency to detect a misinformation effect. However, the fact that a misinformation effect was detected in the linear-random cell provided evidence that the item type manipulation did indeed work<sup>19</sup>. Therefore, this explanation was ruled out.

Having established that the item type manipulation had some effect, an explanation as to why the results from the present study did not conform to the experimental hypothesis was suggested. This proposed that the different slide conditions may have influenced results in a manner that was not intended. Specifically, concerns regarding the suitability of random event slide presentation (i.e., amongst the non linear condition) as a substitute for McCloskey and Zaragoza's (1985) slides were raised. According to this explanation, the random nature of the slides presented to the non linear cells during the encoding phase caused participants to pay increased attention to the slides. That is, the fact that the slides did not have a coherent sequence motivated participants to 'work out what was going on'. This

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<sup>19</sup>The fact that one misinformation effect was detected amongst the four cells does not rule out the possibility of a weak effect size *contributing* to the results. This is discussed in greater detail in the preceding section.

motivation resulted in increased attention (such attention is hereafter referred to as *effortful encoding*) amongst these participants, resulting in more material being encoded. Conversely, the exposure of the linear cells to sequential presentation would have encouraged a more passive style of encoding (hereafter called *passive encoding*), as the sequence of events would not have caused participants to pay extra attention to the slides. This could explain why the two non linear cells failed to display misinformation effects. That is, the greater attention paid during the encoding phase resulted in better overall memory performance, which in turn meant that these participants were less likely to be influenced by postevent information. As participants in the linear cells adopted a passive encoding style, their memories were less detailed and thus more susceptible to inconsistent misinformation. Such a conclusion is consistent with previous research that suggests that when memories are relatively weak they are more susceptible to the effects of inconsistent postevent information (Chandler, 1989; Payne et al., 1994).

An application of the *effortful encoding hypothesis* to participants' critical item performance indicated that this could provide a satisfactory explanation. Of particular interest was the ability of this explanation to account for the fact that a sequential testing effect was found amongst the linear cells (i.e., a misinformation effect found in the random cell and was not found in the sequential cell), yet was absent from the non linear condition (i.e., neither cell displayed a misinformation effect). The failure to detect an effect of test presentation amongst the non linear condition can be attributed to a ceiling effect caused by participants' effortful encoding strategy. That is, the increased attention caused by the random event presentation meant that participants' memories were already strong, making retrieval easier which in turn made the effect of sequential testing redundant. Conversely, the passive encoding strategy adopted by participants in the linear condition resulted in weaker memories. This meant that they were less likely to be spontaneously retrieved, hence the benefit of sequential testing that was found amongst these two cells.

A interpretation that was similar to the effortful encoding hypothesis was used by Murachver et al. (1996) to account for the relationship they detected between encoding and retrieval strategies. During this study, participants were exposed to one of three encoding conditions: (a) direct participation in an event (direct experience), (b) they witnessed another participant perform the event (witness) (c) they were told a story about the event (story). These three conditions were then assigned to one of two retrieval conditions, either (a) acting out the event (acting out), or (b) providing a verbal description of the event (verbal recall). A main effect of encoding strategy was located. This suggested that recall accuracy increased as a function of the level of participation (i.e., direct experience was highest, the witness group was second, the story group was last). An interaction between encoding and retrieval strategies was also detected. In a manner that was consistent with the encoding specificity principle (cf. Tulving & Thompson, 1973) both the story and witness groups reported an effect of context reinstatement. That is, recall accuracy was highest when the encoding and retrieval conditions were similar (i.e., acting out was most effective for the witness group, whereas verbal recall was more effective for the story group). Interestingly, the direct experience group displayed no benefit of context reinstatement. In this condition, recall accuracy was equally high for both the cells regardless of the nature of retrieval. This finding led Murachver et al. (1996) to conclude that when encoding conditions are optimal, the effect of context reinstatement will be negligible, the implication being, that if memories are initially encoded well they will not benefit from retrieval support. Whilst the Murachver et al. (1996) study differed from the present study's methodology in many respects (e.g., using children instead of adults, overall accuracy rather than a misinformation effect was measured, the encoding and retrieval conditions differed etc.), the fact that the Murachver et al. (1996) interpretation was similar to the effortful encoding hypothesis seemed to bear testimony to the accuracy of this explanation.

Whilst the effortful encoding hypothesis could account for the results of the critical item analysis, it was necessary to determine if this explanation extended to participants' non critical item performance. If effortful encoding was reasoned to boost overall memory performance by increasing participants' attention, any benefits that were found in terms of critical item performance should also have extended to non critical item performance. An examination of the descriptive statistics (see Table 3) suggested that this was not the case. This revealed that one of the linear cells reported the highest score and one of the non linear cells displayed the lowest score. However, the results of an ANOVA conducted upon these non critical item scores suggested that these differences were not significant. The failure to find significantly higher non linear than linear non critical item performance may have been because many of the details that were manipulated to create these test pairs (see Method) were exceedingly small (e.g., a tap on the ground) and peripheral. In comparison, the critical items (e.g., a car and a road sign) took up large amounts of the visual field. That is, as non critical items were small they were unlikely to be noticed, even if people were paying attention. Thus, on the basis that non critical item performance was not a particularly good indicator of participants' overall memory<sup>20</sup>, there remained no reliable way of testing the effortful encoding hypothesis. Therefore, the possibility that random event presentation of Bekerian and Bowers' (1983) slides simply were not analogous to non linear slides could not be ruled out. This meant that although the present results did not support the experimental hypothesis, this explanation could not be rejected outright.

Bekerian and Bowers (1983): An Effect Of Test Presentation Regardless of Slide Linearity

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<sup>20</sup> Support for the notion that non critical item performance is a poor indicator of overall memory, can be found in that none of these authors that have used the same set of slides as Bekerian and Bowers (1983) (e.g., Bowers & Bekerian, 1984; Loftus, 1977; Loftus et al., 1978) have analysed non critical item performance.

Another alternative to the explanation discussed above related to Bekerian and Bowers' (1983) hypothesis. This hypothesis was similar to the experimental hypothesis in that it predicted an effect of sequential testing. However, unlike the experimental hypothesis, Bekerian and Bowers' (1983) explanation was far more general regarding the effects of sequential testing. Whereas the experimental hypothesis predicted that the effect of sequential testing upon misinformation effects would be mediated by slide linearity, Bekerian and Bowers (1983) proposed that sequential test presentation would reduce the deleterious effects of inconsistent postevent information irrespective of slide linearity. From this perspective, both of the cells which received sequential testing (i.e., linear-sequential, non linear-sequential) would receive conditions that were similar to those under which the memory was encoded. This would result in greater accessibility to the original item, and therefore no significant misinformation effect would be detected in these cells. Conversely, participants in the cells which received random testing (i.e., linear-random, non linear-random) would receive conditions that did not match those under which the original item was encoded, therefore the retrieval of the postevent item was more likely. This would result in a misinformation effect for these two cells.

The results from the comparisons conducted amongst the four cells revealed one misinformation effect (i.e., linear-random cell) and one potential misinformation effect (i.e., non linear-random cell) were present. Clearly, as both of these effects occurred within the cells which received random testing, this trend was consistent with the Bekerian and Bowers (1983) predictions. That is, misinformation effects were contingent upon test presentation, regardless of slide linearity.

The evidence for Bekerian and Bowers' (1983) hypothesis became even more convincing when the possibility that the marginally non significant result detected amongst the non linear-random cell may have in fact been significant was considered. Up until now, the discussion of results has assumed that a true misinformation effect was not found amongst this condition. However, it is possible that the failure to find

a significant effect was due to the analysis lacking power. That is, the  $t$  test conducted upon the non linear-random cell may have lacked sensitivity and therefore avoided detecting a misinformation effect. As was reported in the results section, the power analysis suggested that the  $t$  tests used for the specific analyses possessed sufficient power (72%) to detect a moderate (i.e., 0.5) effect size. Therefore, as calculations were conducted using a moderate effect size as an estimate, such power would only be acceptable if the effect size in the present study was either equal to or greater than 0.5. Data from previous research provide the means by which calculations of effect size are based (Cohen, 1990, 1992; Howell, 1997). Unfortunately, the previous research which was concerned with sequential test effects (i.e., Bekerian & Bowers, 1983; Bowers & Bekerian, 1984; McCloskey & Zaragoza, 1985) did not report enough information to allow such a calculation to be conducted. As an indication of effect size was not ascertained, this meant that it was unclear if a moderate effect size was indeed present. If the effect size was in fact smaller than 0.5, the  $t$  tests would have become more conservative. Bearing this in mind, the non significant result detected amongst the non linear-random cell may have been because the misinformation effect in this cell was smaller than expected, thereby resulting in the  $t$  test to fail detecting such an effect<sup>21</sup>. Furthermore, a small effect size could have accounted for the discrepancy between the overall and specific analyses. That is, as overall analyses are less powerful at detecting interaction effects in relation to specific analyses (Howell, 1997), a smaller effect

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<sup>21</sup> One possible reason for a small effect size may have been due to the addition of a new critical item (i.e., the car). That is, participants' memory for this item may not have been susceptible to inconsistent postevent information, thereby reducing the misinformation effect. A pilot experiment suggested that this item was susceptible to misinformation. However, as the present critical items can not be analysed (i.e., there would be an unsatisfactory number of cases in each cell to permit an analysis), this possibility can not be ruled out.

size would further reduce the power of the overall analysis, hence the discrepancy. Whilst such arguments may sound convincing, as the previous research could not give an indication of effect size, they must be accepted with caution. This means that in relation to Bekerian and Bowers' (1983) hypothesis, results can only be said to conform to a 'trend' (i.e., one significant and one marginally non significant misinformation effect was found in the random condition) which is consistent with the pattern identified by these researchers.

#### Concluding Remarks:

The results from the present study made the drawing of firm conclusions problematic. Interpretation was confounded by the two sets of analyses (i.e., overall and specific) reporting conflicting patterns of results. In keeping with McCloskey and Zaragoza's (1985) expectations, the overall analysis suggested that there was no effect of sequential testing. Contrary to this finding, the specific analyses revealed that although each cells' recognition difference scores were in a direction consistent with a misinformation effect, in only one cell, (i.e., linear-random) did this difference achieve significance. However, one other cell, the non linear-random cell, only just failed to report a significant misinformation effect. One possible explanation for these conflicting results, is that the effect of slide type and test presentation were extremely small and therefore less likely to be detected by the more conservative overall analysis (Howell, 1997).

Bearing this in mind, it was decided to focus upon the results from the specific analysis, as these tests possessed greater power, and thus were more likely to detect a small effect size. It quickly became apparent that these results were not consistent with McCloskey and Zaragoza's (1985) predictions that sequential testing had no effect upon misinformation effects. If this had of been the case, all four cells should have experienced misinformation effects. These results were believed to provide some support for Bekerian and Bowers (1983) hypothesis. These researchers expected an effect of sequential testing upon misinformation effects regardless of slide linearity. This explanation was particularly convincing if one is

willing to accept the position that a small effect size may have hindered the specific analyses' ability to detect a misinformation effect in the non linear-random cell. Had this been the case, this would have meant that both conditions would have experienced misinformation effects whilst the sequential conditions avoided such an effect. This pattern of results would have been entirely consistent with Bekerian and Bowers' (1983) account.

However, it would be premature to dismiss the experimental hypothesis as the non linearity slide manipulation did not appear to produce this effect. If anything, it may have encouraged effortful encoding, thereby boosting participants' critical item performance. However, a barrier to this explanation was that analysis of non critical item performance failed to reflect the same pattern of results obtained by the critical item performance. However, as differences between the non critical item pairs consisted of small perceptual details, this form of analysis was unlikely to offer any great insight into participants' memories. This meant that it was unlikely to be a valid method for determining whether or not effortful encoding occurred.

As this conflict is at present irreconcilable, it may be more productive to focus upon the conclusions that can be formed from this study. By focusing upon the two linear cells, it appears that some effect of sequential testing was found. Thus, whilst the potential bias of 'effortful encoding' did not allow precedence to be given to either Bekerian and Bowers' (1983) or the experimental hypothesis, it did suggest that some effect of sequential testing occurred. Thus, amongst these two cells it can be said that sequential testing helped boost participants' memory performance. The implication is that this increase was due to context reinstatement. That is, by testing participants in a sequential fashion, thematic cues that were present during encoding were also available at the time of testing, thereby resulting in the original item being accessed. Conversely, participants who were exposed to random testing did not receive a reinstatement of these thematic cues. Subsequently, they were more likely to access the postevent item at the time of retrieval.



This finding has larger implications for the misinformation effect research. An effect of sequential testing implies that misinformation affects coexistence based memory impairment. From a coexistence perspective, the introduction of inconsistent postevent information is reasoned to create an additional memory representation (i.e., the postevent item) which exists along with the original memory, resulting in this original item becoming less accessible. This finding is clearly at odds with the alteration hypothesis (Loftus, 1979b; Loftus & Loftus, 1980), as well as the misinformation acceptance hypothesis (McCloskey & Zaragoza, 1985), as neither of these explanations can explain the ability of a test procedure to override the effects of inconsistent postevent information under standard test conditions. The present study attempted to reconcile the conflicting results obtained by Bekerian and Bowers (1983) and McCloskey and Zaragoza (1985). The present results could not resolve this discrepancy, although they did suggest that some effect of sequential testing upon misinformation effects was obtained. As such, these results suggest that McCloskey and Zaragoza's (1985) dismissal of their rivals claims were premature. Given the interest in reconciling this discrepancy, the experimental hypothesis warrants further testing (albeit with a refined procedure). By increasing the sample size, the analysis would have a better chance of detecting what may be a small effect size. Furthermore, by developing sets of both linear and non linear slides, the potential bias of effortful encoding could be avoided. It is reasoned that by implementing these changes, a more precise conclusion regarding the association between slide linearity, test presentation and the misinformation effect would be provided.

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## Appendix A

The following section contains the test booklet. It is worth noting that several features of this booklet differ from that used in the experiment. Firstly, the filler tasks also contained a crossword. However, this was unable to be reproduced in the Appendix. Secondly, the questionnaire within this appendix contains all of the possible variations on the postevent questions. For example, the question relating to the road sign critical item, contains both of the postevent alternatives (i.e., stop sign, giveaway sign), as well as its neutral form (i.e., road sign). In the experiment, according to counterbalancing procedures (whether the item was as a control or misled item, as well as the items participants saw during phase one), participants were only ever given one alternative. The first page of the test booklet can be found overleaf.



INFORMED CONSENT

The experiment in which you are about to participate is designed to investigate the reliability of eyewitness testimony. It is being conducted by John Jones, under the supervision of Dr. Susan Gee, as part of his requirement for the fourth year Bachelor of Psychology (Honours) course. The experiment conforms to guidelines produced by the Edith Cowan University Committee for the Conduct of Ethical Research.

In this experiment you will be required to view a set of slides, complete two simple exercises, read a short statement and complete a memory test. The test requires you to nominate the items you saw in the slides from two alternatives, one of which was present in the slides, and one of which was not. Do not worry if you have not done this before as most of the other participants are identical to you in this respect. The aim of this experiment is to evaluate if various visual and verbal modes of presentation can aid memory. This research will hopefully lead to the development of more effective eyewitness questioning procedures.

At no time will your name be reported. All data will be reported in group form only. At the conclusion of the study, a report of the results will be available upon request.

Please understand that your participation in this research is totally voluntary and you are free to withdraw at any time during this study without penalty, and to remove any data that you may have contributed.

Any questions concerning this project can be directed to either myself (08) 9405 1151 or my supervisor, Dr. Susan Gee at the School of Psychology on (08) 9400 5526.

I (the participant) have read the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this activity, realising that I may withdraw at any time. I agree that research data may be published, provided I am not identifiable.

\_\_\_\_\_  
Participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Researcher

\_\_\_\_\_  
Date

Please place your age and gender in the appropriate spaces below, and begin to work through the questions below. When you have finished this page, please turn over the page. However, after finishing the exercises over the page, do not go any further until instructed.

Age \_\_\_\_\_ Gender \_\_\_\_\_

(1) Nine identical packages, each containing one of Mr. Brown's new scalp massaging inventions, had been loaded onto the train. The train was ready to depart when the frantic Brown came running along the platform. "Hold the train" he yelled, "one of my devices is missing its fringe-equaliser. Without it the whole thing might melt when the customer tries to use it."

"Well you better find it quick, we leave in two minutes" said the guard. There was no time to unwrap the packages, but Brown had brought with him a set of scales which would allow him to compare the weights of the parcels against each other. The parcel that was slightly lighter would be the one without the fringe equaliser.

Unfortunately there was only time for two weighings. How could Brown be sure he found the right parcel?

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(2) This is Angela's first time in a three mile fun run, and she is finding it a little tough. In fact she has only just completed the first two miles, and as she looks at her watch and says to herself breathlessly, "I'm only averaging four miles an hour. Oh dear, I wanted to average six miles an hour for this run- I must go a bit faster." How fast will she have to run the final mile in order to get her average speed for the whole Fun run up to six miles per hour?

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(3) Pete's Pizza Pantry has been a rip roaring success so far. "We prize ourselves on our amazingly speedy service," says Pete who likes to take a stopwatch to his hardworking staff as they slave over the grills. He started off with three pizza makers, who could produce in total, three pizzas in three minutes. Now business is booming and he's doubling his staff to six pizza makers. How long will it take them to produce six pizzas?

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(4) Standing in the street in front of a shop window, I can see the name of the shop, in large gilt letters on the window itself, and I can also see it reflected in a mirror inside the shop. Do I see the name on the mirror the right way round, or reversed?

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AFTER COMPLETING THESE EXERCISES. PLEASE TURN OVER

(5) The leopard and the cheetah wanted to find out which of them could run the quickest. "That little stream is 100 paces away, I'll race you to it," said the cheetah. Off they ran, and the cheetah was ten paces ahead of the leopard when she sprang over the stream. "I'm too fast for you," said the cheetah. "I'll tell you what, let's do that race again, but this time you start from the same place, and I will start ten paces behind you." The leopard agreed, and they ran the race again at exactly the same speeds. Who won this time?

---

NB: Crossword inserted and photocopied

PLEASE DO NOT TURN OVER UNTIL INSTRUCTED TO.

## QUESTIONNAIRE

### INSTRUCTIONS

The following 20 questions refer to the events you saw in the slides. Circle the response which is consistent with what you remember. As these questions will be assessed for accuracy it is important that you try very hard to remember the events in the slides, as well as answering all of the questions. Throughout this questionnaire, the person who was struck by the red Datsun is referred to as the pedestrian, whereas the person accompanying the pedestrian is known as the companion. Furthermore, the term driver is used to refer to the person who drove the red Datsun which ran over the pedestrian.

### QUESTIONS

- (1) Can you recall if the driver was wearing glasses at the time he stepped out of the red Datsun? YES      NO
- (2) Was the companion resting against a light pole when the pedestrian was struck by the red Datsun? YES      NO
- (3) Do you remember anyone (e.g., the companion, driver or police officer) moving the pedestrian from the roadside at any stage after the pedestrian was run over? YES      NO
- (4) Was the companion wearing a hat? YES      NO
- (5) Did the driver pass anyone whilst he was running away from the scene of the crime? YES      NO
- (6) Was the car the police officer arrived in white? YES      NO
- (7) Did the surface of the road upon which the accident occurred appear to be dry? YES      NO

AFTER YOU HAVE FINISHED QUESTION 7, PLEASE TURN  
OVER THE PAGE

(8) Was the companion wearing a yellow striped shirt?

YES NO

(9) Do you recall if, at any stage, the police officer used his radio to summon help?

YES NO

(10) When you saw the driver emerge from the red Datsun, do you remember if there was someone else sitting in the vehicle?

YES NO

(11) Was the pedestrian struck at a pedestrian crossing (denoted by two white lines)?

YES NO

(12) Circle 'yes' if you remember the driver having a beard.

YES NO

(13) Was anyone leaning out of the green car/ yellow car/ car that passed the accident scene?

YES NO

(14) Did the driver bend over and touch the pedestrian when he was on the road?

YES NO

(15) Was the companion looking in the pedestrian's direction at the moment he was hit by the red Datsun?

YES NO

(16) Circle 'yes' if you believe the pedestrian was wearing a long sleeved shirt.

YES NO

(17) Did a pedestrian walk in front of the red Datsun when it stopped at the stop/giveway/road sign?

YES NO

(18) Did the pedestrian look to his left before crossing the road?

YES NO

(19) Circle 'yes' if you think the red Datsun was a convertible.

YES NO

(20) Did the pedestrian have black hair?

YES NO

AFTER COMPLETING THIS EXERCISE, PLEASE DO THE TASK OVER THE PAGE

## INSTRUCTIONS

Please work through the examples below, when you have finished the examples on this page, complete the exercises on the next page. However, after completing these, please do not go any further until instructed to.

(1) "My people are not being polite enough," declared King Ogbad the Genteel to his courtiers. "By royal decree, all people must now shake hands more often. To make sure that this is carried out, I order you to count how many times each person shakes hands with another in the next year. And should your answers be even the slightest bit wrong, off with your heads!" he bellowed. And so that year, the courtiers journeyed throughout the land. Determined to record every handshake, they worked diligently throughout the day and often late into the night. At the end of the year the chief courtier was summoned to the king to announce the results. "Sire, every greeting has been witnessed, every secret liaison has been spied, and every handshake has been recorded." Pointing to the vast stacks of paper piled to the palace ceiling he announced "Here are the results which have taken several weeks to count. And the grand total was..."

"Silence" ordered the king. "Tell me first, how many people shook hands an odd number of times?" "Well let me see... it was 2143", replied the courtier after he had looked through his summary. "Then you have miscounted!" roared King Ogbad. "Off with your heads the lot off you!"

How could the king be so certain that the counting was wrong?

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(2) Scruffy Sam has put on his T-shirt. Unfortunately it is inside out and back to front. Normally the washing label is on the inside of his left sleeve. Where is it now?

---

(3) The famous archaeologist Professor von Spitzbender was looking at some interesting old carvings on a cave wall. "Mmm, zis appears to be a diagram of a pyramid," he said. "Let me study it through my magnifying glass." The magnifying glass makes all of the sides of the pyramid appear three times as long. "Aha, zis corner of ze pyramid appears to be exactly 60 degrees," said the Professor. What is the angle of the corner before magnification?

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(4) "So Mister Bond, now that I have shown you how I plan to take over the world, it is time for me to put you to a slow and agonising death. I have stripped you of your shirt and tied you so you can not move. I am going to seal you into this airtight chamber, with barely enough room to swing a cat. It is so well insulated that no heat can enter or leave it. In the chamber you will notice I have left a large kitchen freezer with the door jammed open! Already the chamber is only five degrees Centigrade. Goodbye and say your prayers...Mr Bond".

How long do you think James has to manufacture his escape before he freezes to death: minutes, days, or hours?

---

WHEN YOU HAVE FINISHED, PLEASE TURN OVER.

(5) Jane Higgins was walking down the road when she bumped into an old friend.  
"Hello, I haven't seen or heard from you since graduation back in 1982!" said Jane,  
"What's happened to you?"  
"Well, I got married in 1989 to somebody you wouldn't know. This is our son," said  
the friend, who was holding hands with a little boy.  
"Hello and what's your name?" said Jane to the boy.  
"It's the same as Daddy's".  
"Ah, so it's Peter is it?" said Jane.  
How did Jane know?

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NB. Crossword inserted here and photocopied

AFTER YOU HAVE FINISHED, PLEASE DO NOT TURN OVER UNTIL  
INSTRUCTED OTHERWISE

RESPONSE SHEET  
INSTRUCTIONS

During the following exercise you will be shown some more slides. These will be presented in either single order or in pairs. The pairs are made up of one slide you saw previously and one which you have never seen. Your task is to indicate which slide you saw before in the spaces below. For example, if you think you saw the slide that appeared on the left of the pair, place a tick in the left hand column. Please make sure you complete each space.

	LEFT	RIGHT
Pair 1	_____	_____
Pair 2	_____	_____
Pair 3	_____	_____
Pair 4	_____	_____
Pair 5	_____	_____
Pair 6	_____	_____
Pair 7	_____	_____



Appendix B

Using SPSS For Windows, participants' scores were subjected to a 2 x 2 (x 2) split-plot factorial ANOVA. The between-subjects independent variables were slide type (linear vs. non linear) and test presentation (sequential vs. random). The accuracy of postevent information served as a within-subjects independent variable, with each participant receiving both misled and control items. Overall recognition accuracy on both misled and control items served as the dependent variable. The categorical nature of the dependent variable would not allow a normal distribution to be constructed. However, results from the Levene's test for both misled,  $F(3, 112) = .916, p = .436$ , and control,  $F(3, 112) = 1.090, p = .357$ , items suggested that the homogeneity of variance requirement was fulfilled.

Out of all the main and interaction effects, postevent information was significant effect that was detected,  $F(1, 112) = 11.641, p = .001$ . This suggested that recognition accuracy was increased as a function of the accuracy of postevent information. A summary of the results is presented in Table B2.

Table B1  
Results From The ANOVA Regarding Main and Interaction Effects

Variable(s)	df	F	p
Postevent	1	11.641	.001*
Slide	1	.413	.552
Test	1	.017	.898
Postevent x Slide	1	.550	.460
Postevent x Test	1	.550	.460
Postevent x Slide x Test	1	.022	.882

Note: \* $p < .05$

## Appendix C

Table C1

Parameter Estimates Obtained Regarding First, Second and Third Order Effects

Variable	Parameter	z
Difference x Slide x Test		
-1 x non linear x random	-.162	-.784
0 x non linear x random	.141	1.038
Difference x Slide		
-1 x non linear	.038	.185
0 x non linear	.059	.418
Difference x Test		
-1 x random	-.173	-.838
0 x random	.068	.482
Slide x Test		
non linear x random	-.067	-.556
Difference		
- 1	-.897	-4.332
0	.731	5.199
Slide		
non linear	-.012	-.100
Test		
random	-.055	-.463

## Appendix D

Due to the concern regarding the application of one sample  $t$  tests to data which was not normally distributed, each of the four cells' control and misled scores were subjected to Wilcoxon Signed Ranks Tests to see if there was a misinformation effect (i.e., significantly lower misled performance relative to control performance). Whilst performance on the control items was better than misled item performance for each of the four cells, the linear-random group was the only cell in which this difference was significant,  $z = -2.138$ ,  $p = .033$ . In each of the other cells: linear-sequential,  $z = -1.732$ ,  $p = .083$ ; non linear-random,  $z = -1.897$ ,  $p = .058$ ; and non linear-sequential,  $z = -.832$ ,  $p = .405$ ; the difference between control and misled item performance was not significant.